ELEVENTH ANNUAL REPORT
MARCH 31, 1986

Alberta

OIL SANDS TECHNOLOGY
AND RESEARCH AUTHORITY

87-02329/

TO HER HONOUR
HELEN HUNLEY
LIEUTENANT GOVERNOR OF THE PROVINCE OF ALBERTA

Madam:

I have the honour to submit the Annual Report of the ALBERTA OIL SANDS TECHNOLOGY AND RESEARCH AUTHORITY for the fiscal year ended March 31, 1986.

Respectfully submitted

Neil Webber.

NEIL WEBBER
Minister of Energy

OIL SANDS TECHNOLOGY
AND RESEARCH AUTHORITY

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Foreword

On January 14, 1974, the Premier of Alberta announced the availability of $100 million to develop new technology for the recovery and processing of petroleum from the Alberta oil sands. The terms and conditions for the disbursement of these funds are described in The Oil Sands Technology and Research Authority Act, passed by the Legislature in June 1974 and since amended to include the recovery of heavy oils and the enhanced recovery from conventional petroleum reservoirs. Additional monies have since been dedicated by the Alberta Government to permit the funding of longer term programs.

AOSTRA Field Pilot Projects

Chairman's Report

Eleventh Annual Report of the Alberta Oil Sands Technology and Research Authority

To The Honourable Neil Webber
Minister of Energy

Sir:

I have the honour to present the Eleventh Annual Report of the Alberta Oil Sands Technology and Research Authority for the year ended March 31, 1986.

The Eleventh Annual Report comes at a time when the price of oil has declined to its lowest level in eight years and the need for all forms of research is being reviewed by the petroleum industry. Fortunately, the Government of Alberta recognizes the need for a steady effort in research and is providing the funding necessary for AOSTRA to continue its research program during this downturn in the business cycle. AOSTRA has proven to be a good vehicle for the government to invest its research dollars, because of its successful collaboration with industry, universities, and other research organizations. This close association has led to the rapid transfer of technology to our industrial partners and the immediate commercial application of this technology in many cases. As a result of a massive and sustained team effort in Alberta by industry and government, in situ production is now a commercial reality in two of the major oil sand deposits - Cold Lake and Peace River.

Good progress is being made at three experimental pilots in the Athabasca deposit and it is confidently expected that within ten years in situ production from this deposit could become commercial.

The early promise of the carbonate trend has not been realized, and the low ratio of successful to unsuccessful wells need explanation. It is expected that better knowledge of the geological history and confining mechanisms is the key to explaining these results.

The low oil price is also responsible for the reluctance of industry to apply advanced enhanced recovery methods to conventional reservoirs. This will accelerate the decline in conventional production if allowed to continue; therefore, AOSTRA will be making special efforts to encourage industry participation in this important program.

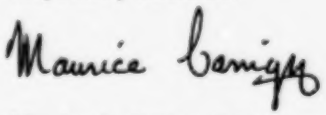
With the decline in conventional light oil production and its replacement with heavy oil and bitumen, more attention will be focused on the upgrading of these heavy oils and bitumen. For this reason, AOSTRA will be concentrating more on advanced upgrading processes, particularly those that offer high liquid yield and low sulfur dioxide emissions.

Concomitant with the research on new upgrading processes, research on residue utilization is proceeding so that introduction of new processes will not be delayed by environmental and conservation concerns about residue use and disposal.

It is evident that synthetic oil production will be playing an even larger role in Canada's liquid fuel supply. The transition from light crude oil to synthetic crude oil will only proceed smoothly if the recovery and upgrading technology is ready for commercial application when that time comes. The role of AOSTRA is to anticipate the future needs in oil sands and heavy oil development and to make sure that no gaps remain in the technologies required.

I am confident that as you read this annual report, you will observe that work is going on in every aspect of the many technologies needed to reach our goal of increasing the commercial production of synthetic oil from Alberta's oil sands.

Respectfully submitted,



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1 In Situ Oil Sands Recovery Program

1.1 AOSTRA-AMOCO Gregoire Lake Pilot Project

An agreement between AOSTRA, Amoco Canada Petroleum Company Ltd, and Petro-Canada Exploration Inc. was signed early in 1984 to conduct a new pilot approximately 15 km NE of the Block 1 pilot using steam and steam plus additive processes. The delineation wells and one production well for the new pilot have been drilled and tested to determine reservoir characteristics and the pilot surface facilities completed. Drilling of the remaining four-spot pattern injection, production, and observation wells will be completed in 1986 with operations to commence late in 1986. A unique 3-D seismic pattern has been installed to monitor heat front movement during the project operation.

1.2 AOSTRA-BP Marguerite Lake Pilot Project

The AOSTRA/BP Exploration Canada Limited project, located in the Clearwater sandstone of the Cold Lake oil sands deposit, is designed to test steam stimulation followed by wet combustion. Dome Petroleum Limited and PanCanadian Petroleum Limited are also participants in the project.

The project is now in its eighth year of operation and the initial steam stimulation phase is complete. Concurrent special test wells of air injection confirmed the original plan to follow the steam stimulation phase with air injection to improve ultimate recovery. Feasibility studies led to a decision to use oxygen instead of air for the combustion phase. A total of five wells in the main pattern have been converted to oxygen injection. Results during 1985 were encouraging and oxygen injection operations are planned for 1986.

Based on the early steam stimulation results BP was joined by Petro-Canada Exploration Inc. in the development of an 1100 m^3/day project, surrounding the pilot area. This project is known as Wolf Lake and the first production started in April 1985.

BP is currently considering an addition to this project and is also investigating the use of the oxygen combustion technology which is being developed by the pilot.

1.3 AOSTRA-BP B-Unit Pilot Project

AOSTRA, BP Exploration Canada Limited, and Petro-Canada Inc. are conducting a single-well cyclic steam stimulation project (B-Unit pilot) with two observation wells in the Lower Grand Rapids formation of the Cold Lake oil sands deposits. The object of the B-Unit pilot is to improve bitumen recovery by testing novel fracturing/injection methods which were developed at the AOSTRA-BP Marguerite Lake pilot, 10 km to the north. The producing zone is 16 m thick at a depth of 430 m. The fourth steam stimulation cycle will be completed by mid-1986.

1.4 AOSTRA-SHELL Peace River Pilot Project

The AOSTRA-Shell Canada Resources Limited/Shell Explorer Limited Peace River Project, located 30 km NE of Peace River, was designed as a prototype installation. Amoco Canada Petroleum Company Limited was also a participant in this project.

At the pilot site, the oil sands are 550 m deep and 27 m thick. The oil sands deposit under the Shell lease has a bottom interval of high water saturation, averaging 3 m, which has provided an initial path for steam movement at the base of the reservoir.

The test is evaluating cyclic pressurization of the reservoir using steam. This process was extensively investigated by physical and mathematical simulation tests prior to the field tests.

Steam stimulation, the first and second pressurization cycle, and the first blowdown of the producing wells have been completed and approximately 33% of the original oil-in-place has been produced. Additional single well cyclic steam operations were conducted throughout 1985 and will continue throughout 1986 in four off-setting wells. One well is testing the use of natural gas as an additive to steam to improve cyclic performance. The results will provide information on the viability of cyclic steam stimulation as a precursor to the cyclic pressurization recovery process under development in the main pattern area.

The operator has constructed a commercial demonstration project with a capacity of 1600 m^3/day from 216 wells. AOSTRA is not a direct participant in the commercial pilot, but the existing pilot facilities and technology have been incorporated into the new project. AOSTRA'S and Amoco's direct participation terminated at the end of 1985, but AOSTRA will continue to receive project data.

1.5 AOSTRA-UNOCAL Buffalo Creek and McLean Pilot Projects

Activity with Union Oil Company of Canada Limited and Canadian Superior Oil Limited to develop technology to produce the very large reserves of bitumen in the Devonian carbonate formations continued throughout the year.

This project is located in an isolated area approximately 100 km west of Fort McMurray, and tests since 1977 have been conducted in the Grosmont 2 and 3 formations to examine the suitability of steam stimulation, steam drive, and wet combustion processes.

A five-spot pattern (McLean pilot) was completed in 1983. The initial results indicated a geological anomaly within the pilot area. In order to maintain the initial pilot concept, two additional wells were drilled in early 1984 and operations continued through 1985. A special test program is planned for 1986 to investigate the relation of geology and well operations at the McLean pattern. Two new production wells for cyclic steam operations were drilled at locations off-setting McLean and will be operated throughout 1986.

1.6 AOSTRA-CANTERRA-TENNECO Kearl Lake Pilot Project

This pilot is located 77 km NE of Fort McMurray, and is operated by Canterra Energy Limited. Tenneco Energy Ltd is also a participant. The pilot is testing a steam drive process in the McMurray sandstone which, in this area, is at a depth of 150 m and is about 43 m thick.

The pilot consists of two patterns: The "A" pattern is an inverted seven-spot with seven steam injection wells and six producers. The "B" pattern was drilled as an inverted five-spot with nine steam injection wells and four producers and subsequently infill drilled in 1984 to form an inverted nine-spot. Operations began in the "A" pattern in December 1981.

The results of the "A" pattern operation have been encouraging and are planned to continue throughout 1986. Based on the results of the "A" pattern, recovery operations commenced in the "B" pattern early in 1985 and are planned to continue through 1986.

1.7 AOSTRA-COLD LAKE-BOW VALLEY Pilot Project

Bow Valley Resource Industries Ltd, with AOSTRA and Cold Lake Heavy Oil Ltd, operate a steam pilot consisting of an inverted seven-spot pattern to test the use of dry/superheated steam plus carbon dioxide and clay stabilization additives for recovery of bitumen from the Cold Lake Clearwater horizon.

The pilot is located on a Gulf Canada Resources Inc. oil sands lease near the site of an earlier steam pilot operated and suspended by Gulf. Pilot results from a modified test procedure were encouraging throughout 1985 and operations are planned to continue in 1986.

1.8 AOSTRA-CHEVRON-CANADIAN OCCIDENTAL Algar Carbonate Pilot Project

Early in 1985, a single-well, one cycle steam stimulation test was completed in the Grosmont carbonate, with Chevron Canada Resources Limited as operator. Canadian Occidental Petroleum Ltd was also a participant in this test. The test is located 70 km SE of the Union Buffalo Creek pilot. The results of the test indicated that the reservoir setting at the site did not offer encouragement for further operations at this time. Analysis of the results will be completed in 1986.

1.9 AOSTRA-SUNCOR-CANADIAN WORLDWIDE ENERGY Fort Kent Steam Additive Study

AOSTRA, Suncor Inc., and Canadian Worldwide Energy Limited are conducting an engineering and feasibility study on the use of steam additives to improve oil recovery at the Suncor Fort Kent commercial demonstration operation in Cold Lake. The study is built on the patented steam plus carbon dioxide and naphtha additive process developed by AOSTRA at the Alberta Research Council. The study continued through 1985 and is planned to be completed in 1986. A decision to field test an additive system will follow the study completion.

1.10 Texaco Fort McMurray Horizontal Well Project

AOSTRA continued to acquire operating data on three horizontal wells operated by Texaco Canada Inc. in the Athabasca field near Fort McMurray, until October 1985. Texaco has since suspended operation of these wells.

AOSTRA is currently actively pursuing horizontal well technology at its underground test facility northwest of Fort McMurray, and is examining other possible applications of the technique in other heavy oil pools within the province.

1.11 AOSTRA-Industry Mineralogical Transformation Study

AOSTRA is the operator in a cooperative industry-supported research program with eight other participants to conduct a state-of-the-art review of the available confidential and public information on mineralogical transformations occurring during thermal recovery. RES-SEN (Reservoir Technology Limited) is the contractor conducting the review for the first phase of the study at a cost of $55,000. Further research will be considered upon completion of this review.

1.12 Data Base Management System

The AOSTRA Data Base System (ADBS) is a computerized data management system designed to store and disseminate operating data from in situ pilots, and is suitable for both thermal and non-thermal projects.

The ADBS storage format provides for extensive reporting in tabular and graphical format on both raw and processed data. Subject to confidentiality clearance on an individual project basis, direct access by computer terminals is available to users from both pilot sites and central office locations. The ADBS Command Language component can be used for "non-routine" access to data to support special engineering studies. A complete set of plot formats can be produced to illustrate in situ project performance.

The ADBS system software and data presently reside at the Canada Systems Group Service Bureau in Calgary. Field data acquisition systems located at pilot sites can be easily linked to the ADBS to provide a smooth flow of data into individual project data bases.

In addition to the mainframe ADBS, AOSTRA is developing a microcomputer-based system for storing and manipulating pilot data. This system offers the advantages of greater flexibility in data manipulation, increased user control, and reduced cost. The microcomputer-based system ADBS II is scheduled for availability in the third quarter of 1986.

Since inception in 1979, ADBS expenditures have been $2,791,010 and revenues generated from usage by pilot projects are $2,030,983.

1.13 Computer Modeling

An agreement with the Computer Modelling Group (CMG) in Calgary was completed at year end. Extensive use of CMG models was made by AOSTRA staff for analyzing project performance as well as examining potential new areas of investigation which require mathematical simulation.

A new agreement is being negotiated which will permit continued access by the staff to the current CMG models and provide for development of new or improved models.

1.14 Economic Studies

During the year, H.J. Ruitenbeek Resource Consultants Limited has continued to supply economic analysis on selected pilot projects as required.

A major review of one in situ project was completed on behalf of AOSTRA and the project operator.

An economic model for evaluating and monitoring the commercial possibilities of new and existing in situ production projects was developed and is now available for use. A cost data base is incorporated in this model and will be updated as appropriate by the consultant.

2 Underground Test Facility (UTF)

For almost ten years, AOSTRA has supported studies evaluating the shaft and tunnel access (SATAC) method of placing an array of horizontal wells low in the formation to promote high recovery of bitumen from oil sands. In 1982, AOSTRA initiated a new study at a site, on Crown land, 17 km west of the Syncrude Canada Limited mining operations. Norwest Resource Consultants Limited of Calgary was commissioned to provide a design and cost estimate of an Underground Test Facility (UTF), which would provide access for underground thermal in situ recovery piloting. As a result of this study and previous work, AOSTRA dedicated $43 million to construct the first stage of the Facility.

This field project was started in 1984. After a review of the suitability of the Crown land site, further study and preliminary discussions with potential industry participants, AOSTRA contracted for the sinking of two shafts and the driving of the initial tunnels. A 37 km access road to the site was completed during the year. Harrison Saturn Joint Venture was retained in July 1984 for the detailed engineering, procurement and construction of these facilities. Field work began in November 1984. Two shafts have been finished and construction of the initial 350 m of tunnels is well underway. The access facilities should be in place by the end of May 1986.

By May 1985, the access project was well established in the field and a 16 company industry steering committee was working closely with the AOSTRA project team in process screening and reservoir evaluation studies. In this past year, the project has moved from the access and planning work into implementation of the subsequent drilling and testing program.

A custom underground drill rig is being designed and fabricated by Drill Systems in Calgary and will be ready for testing in the summer of 1986.

Overall the project is progressing well. On the presently planned schedule, process pilot operations will begin early in 1987.

3 Enhanced Recovery Program

3.1 AOSTRA-ALBERTA ENERGY Suffield Heavy Oil Pilot Project

This project, located in the Suffield military block in southern Alberta, is operated by Alberta Energy Company Limited (AEC) on behalf of AOSTRA, Dome Petroleum Limited, and Westcoast Petroleum Limited. The pilot is located in the glauconite sandstone and is testing a wet combustion process in a 19.5 m thick heavy oil reservoir underlain by water. The initial test pattern is an inverted five-spot covering two hectares.

Air injection into a central well commenced in February 1982 and water injection for the wet combustion phase began in early 1983.

Production to date has been significantly greater than would have been achieved under primary production. Pattern operations will continue throughout 1986 with the addition of an off-set production well. An off-set single well gas injection test will also be conducted during 1986.

3.2 AOSTRA-VIKOR RESOURCES Joffre Viking CO_2 Miscible Pilot

Vikor Resources Limited, on behalf of AOSTRA and the unit participants, operate the Joffre Viking carbon dioxide miscible pilot which is located in a previously waterflooded and abandoned segment of the Joffre Viking pool in central Alberta. The pilot is located in a lower Cretaceous (Viking) sandstone reservoir and is testing the ability of a CO_2 miscible flood to recover tertiary oil from a 3 m thick, light gravity oil reservoir which had previously been waterflooded. The initial pilot consists of two five-spot patterns, each covering 64 hectares.

Carbon dioxide injection into one of the patterns commenced in January 1984, and into the second pattern in July 1984. Carbon dioxide injection is planned to continue for three years. Water injection is being alternated with carbon dioxide injection (WAG process) for fluid mobility control. Production response to carbon dioxide injection was evident during 1984.

The gross cost of the project is estimated to be $20 million and it is planned to operate through 1987. Results to date have been very encouraging and the unit owners completed a commercial expansion consisting of eight wells in an area offsetting the pilot in July 1985.

3.3 AOSTRA-PETRO-CANADA Viking-Kinsella Pilot Project

This project was designed to compare combustion and steam flood performance in a thin (4 m) Lloydminster-type heavy oil reservoir. The steam pattern was suspended at the end of 1981 due to generally poor performance and the combustion project was terminated in December 1985.

The majority of the wells are now abandoned and facilities have been dismantled.

A substantial amount of useful information was obtained and final analysis and reporting is currently close to completion. A decision on further work in this type of reservoir will be based on this analysis.

3.4 AOSTRA-HUDSON'S BAY (DOME) Cessford Caustic Flood Test

Tracer tests were conducted on two wells in the Basal Colorado "A" pool by Hudson's Bay Oil and Gas Company Limited in mid-1980 to evaluate this pool as a candidate for caustic waterflooding. The tests determined that the technique was effective for measuring residual oil saturations before and after a caustic waterflood. AOSTRA acquired the results of the tests in June 1981.

In July 1984, caustic waterflooding commenced in selected areas of the pool. Additional laboratory tests indicated that oil recovery could further be improved by the addition of polymer to the caustic flood. Injection of polymer was initiated in January 1985. The injection of caustic polymer chemical slug will continue until early 1988. An agreement for AOSTRA participation in the pilot was completed in March 1986. The gross costs for the incremental caustic polymer waterflood pilot are estimated to be $4.9 million.

3.5 AOSTRA-NORCEN Bodo Field Pilot

AOSTRA and Norcen Energy Resources Limited are conducting a comparison of steamflooding versus combustion in the Bodo field. This is a low gravity pool (13.5° API) located in east central Alberta producing from the Mannville "B" sandstone at a depth of approximately 735 m. Norcen's partners in this project include Texaco Canada Resources Ltd, Murphy Oil Company Limited, and Canadian Occidental Petroleum Limited.

A nine-spot steam pilot has been constructed off-setting the combustion operations in the Bodo field. AOSTRA is contributing 20% of the cost of the steam pilot which began operations in mid-1985 and will continue throughout 1986.

3.6 AOSTRA-PANCANADIAN Countess "B" Combustion Project

AOSTRA, PanCanadian Petroleum Limited, and LL&E Canada Limited have agreed to cooperate in a Countess "B" pilot, located 20 km west of Brooks, Alberta. The pilot, consisting of a 16 ha inverted five-spot pattern and associated surface facilities, is designed to evaluate a wet combustion recovery process in the waterflooded Countess Upper Mannville "B" pool. This pool contains medium-gravity oil of 28° API at a depth of 1066 m with a pay thickness of 7.6 m.

PanCanadian is operating and financing the field pilot with LL&E. AOSTRA is funding a research program to support the pilot activities, with the field and research results being shared among the parties. AOSTRA is the owner of, and licensing agent for, the technology being developed both in the field and in the laboratory.

Pilot operations were encouraging during 1985 and will continue through 1986. The research program included detailed examination and testing of a core taken from a fireflooded portion of the field. Numerical model and core flood testing programs have begun to investigate the reservoir recovery mechanism.

3.7 Heavy Oil Lifting Project

From its inception in 1979, this program has investigated, evaluated, and tested heavy oil pumping systems and related parameters. Each phase of the program was directed by an industry consortium with work activities performed by Calgary-based Pengalta Research and Development Limited.

Three promising pump designs from Phases I and II were modified for testing in Phases IIIA and IIIB. The testing resulted in a new pump design, the components of which have been patented, and negotiations are underway with an Alberta-based manufacturer for construction and marketing of the pump.

3.8 Emulsion Treating Study

Pengalta Research and Development Limited was contracted by a consortium of six industry companies and AOSTRA in February 1984 to perform a state-of-the-art review of emulsion treating primarily from an equipment viewpoint. The resulting study is being actively marketed.

4 Produced Water Recycling Program

4.1 Produced Water Treatment Project

Conventional, steam-assisted, in situ oil recovery techniques require substantial quantities of reasonably high quality feedwater for steam generation purposes and yield nearly equivalent quantities of brackish, oily produced water. Because of the scarcity of fresh water supplies in many of western Canada's oil producing regions, and environmental pressures to explore alternatives to produced water disposal, the long-term development of steam-assisted oil recovery methods will be enhanced with their ability to reuse produced water.

In 1982 AOSTRA and twelve industrial participants initiated the Produced Water Treatment Project to identify, evaluate, and ultimately select for demonstration, alternative technologies to economically treat produced waters to boiler feedwater quality specifications.

With the completion of Phase III of the project in 1985, detailed technical and economic evaluations of fourteen treatment systems for treating three produced water qualities for four types of steam raisers were carried out. The most promising processes in a given system were identified and a field test program developed. Phase IV was developed to verify the assumptions used in the detailed evaluations.

The total cost of Phases I, II, and III was $754,000. AOSTRA's share was $330,000.

The project agreement was terminated at the conclusion of Phase III, due to lack of sufficient industry participation. However, the Authority remains committed to the development of improved technology in the area of produced water treatment and is currently evaluating a number of related proposals from individual industry participants.

4.2 Brackish Water Treatment System

In response to an AOSTRA invitation for applications in the field of produced water treatment, a two-phase project was undertaken with Hankin Environmental Systems Inc. The initial phase was to model and compare the commercial economics of the Hankin water treatment system, with a utility boiler, against conventional hot lime treatment with a once-through steam generator. The basis for the treatment and re-use of the produced water was from a 3200 m^3/day in situ operation. The second phase was to demonstrate the performance of the Hankin treatment system through field trials.

Following the Phase I comparative economic study, bench-scale field trials of the Hankin system were conducted at Shell's Peace River in situ pilot plant to establish an optimum process flowsheet and confirm the capital and operating costs developed in Phase I. Total cost of the project was $485,000 and was 100% funded by AOSTRA.

The results of the field trials indicated that the Hankin system, which is based on membrane technology, was capable of producing a high quality treated water suitable for use in a large high pressure utility boiler. The economics were reassessed based on field test data and the capital and operating costs were found to be approximately 10% lower than the conventional treatment system with a once-through steam raiser.

The economic incentive for the Hankin Process was valid, however, only for large utility boiler installations utilizing the economics of scale to offset the higher water treatment cost. Because of this limitation, AOSTRA does not intend to pursue the development of the Hankin Process.

5 Surface Mining/ Extraction Program

5.1 Taciuk Direct Thermal Processor

The development of the Taciuk Direct Thermal Processor continued throughout the current year. The Taciuk Processor is a dry retorting process that has been developed by AOSTRA and UMATAC Industrial Processes, Division of UMA Engineering Limited, for the extraction and primary upgrading of bitumen from mined oil sands. A 5 t/hour pilot plant has been in operation in Calgary since 1978, during which time several thousand tonnes of oil sand of various grades and origins have been processed successfully. Since 1977, total project expenditures have amounted to $14,187,000. All of this funding has been provided by AOSTRA.

A 90 t/hour field demonstration unit was designed for an Athabasca location. Successful operation of such a plant would serve to provide user confidence in the process, necessary for commercial operations. AOSTRA has been seeking participation in the demonstration plant project from potential user companies.

An independent engineering study of the proposed demonstration unit was carried out by Bantrel Group Engineers. This study confirmed the acceptability of the UMATAC design and the corresponding capital and operating cost estimates.

A preliminary examination of the economics of a small scale, 1600 m^3/day oil sands mining project, producing unhydrotreated distillates, indicated a good possibility for an economic return in the first phase of a staged oil sands mining project.

The possibility exists that the processor may be successfully applied in other industries for processing feedstocks other than oil sands; in particular oil shales and hazardous waste materials found in refinery waste dumps. Preliminary batch tests have been carried out on oil shales from the United States and Australia with encouraging results. An extensive bench scale testing program will be carried out by AOSTRA and UMATAC on behalf of Southern Pacific Petroleums NL in the coming year. The oil shale for this program will be obtained from the Stuart deposit in Queensland, Australia. If the test results confirm Southern Pacific's expectations, it is intended that a large scale test in the continuous flow pilot will be carried out in Calgary.

Batch tests were also performed on samples of refinery waste. The results indicated a good potential for component separation and oil recovery. Further investigation of this use for the processor is planned.

5.2 INPROTAR MEP-1001 Extraction Process

Inpro Engineering Limited has conceived a bitumen extraction process based on the principle of gentle slurrying of bitumen with hot water. The purpose of the gentle slurrying is to minimize the formation of emulsions, and thereby improve the bitumen separation and recovery.

The project was initiated in 1984 and completed in the first quarter of 1985 at a total cost of $162,000, funded 100% by AOSTRA.

A 100 kg/hour test facility was constructed in Edmonton and operated using 7.4% and 11% screened oil sand as feed. Various flow configurations were examined from a simple, direct recycle around the main separation vessel to an extensive recycle scheme that incorporated two stages of hydrocyclones, flotation, and settling ponds.

Overall, the process proved less satisfactory than expected, both in the performance of the pilot and in the recovery of bitumen. Bitumen recoveries were found to be less than those possible with the hot water extraction process.

5.3 Coke Desulfurization Project

Nova/Husky Research Corporation Ltd carried out a $186,000 basic research project on direct oil sand retorting for AOSTRA and Canstar Oil Sands Limited in 1984. The project funding was shared by AOSTRA and Canstar on a two-thirds/one-third basis, respectively. Although the objectives were aimed primarily at optimizing product yield, it was also determined that the addition of calcium to the oil sand feed favorably affected the flue gas sulfur levels during coke burning.

Based on this previous work, Nova/Husky has recently begun work on a further project designed to optimize the sulfur capture effects of calcium addition during direct retorting of oil sands. The effects of origin of limestone, particle size, and calcium-to-sulfur ratio, on the sulfur capture will be studied. It is the intent of the project to determine whether calcium addition would be of ultimate value to dry retorting processes such as the AOSTRA-sponsored Taciuk Dry Retorting Process. This second investigation began in early 1986, with expectations of a spring 1987 completion date. The $176,000 project is being funded 95% by AOSTRA and 5% by Canstar Oil Sands Limited.

5.4 Recovery of Oil From Tailings Sludge

AOSTRA and Suncor have funded, on a 75% - 25% basis, respectively, the Oleophilic Sieve Development Company of Canada Limited (OSDCL) to test and develop the oleophilic sieve process (the Kruyer process) for extracting hydrocarbons from the tailings sludge produced by the hot water extraction of bitumen from mined oil sands.

The Kruyer process is a novel extraction concept which uses an oleophilic sieve wrapped around an apertured drum that is partly filled with oleophilic balls. The oleophilic balls strip and agglomerate the bitumen from the sludge feedstock which is then captured on a coated surface of a perforated sieve, while water and solids are allowed to pass through the sieve openings.

The project consisted of two phases. Phase I entailed engineering, procurement, construction, and performance testing of a 1 t/hour continuous pilot plant, in Edmonton and was completed in May 1985, at a cost of $740,000.

Phase II entailed skid mounting the existing pilot and relocating it to the Suncor plant site in Fort McMurray for extended testing on various sludge streams. Phase II testing was completed in November 1985, and cost $400,000. The results of the field tests will be evaluated during 1986 to determine if further development work is required or justified.

5.5 Oil Sands Demonstration Center

AOSTRA, the Federal Department of Energy, Mines, and Resources (EMR) and a number of companies holding mineable oil sands leases have been investigating the feasibility of constructing an Oil Sands Demonstration Center (OSDC) in the Fort McMurray area of Alberta. The OSDC would be a cooperative, shared-cost facility able to accommodate large scale, long-term testing of new and improved technologies applicable to mined oil sands. The purpose of the OSDC would be to provide oil sand feed, utilities, waste disposal facilities, and other infrastructural needs which are essential for the field demonstration of new equipment and processes on a semi-commercial scale. This concept should encourage the development of improved technologies by minimizing the costs associated with the repeated construction of common infrastructural services. These services would be provided to developers and users of new technologies on a fee-for-service basis.

Phase I of the project, which entailed organization, was initiated in January 1981, and completed in July 1981. The participants in this phase consisted of AOSTRA and 19 oil sands lease holders, all of whom shared equally the Phase I total cost of $56,671.

Phase II of the project, including preliminary design, identification of candidate sites, marketing survey, preliminary negotiations for agreements and contracts with industry, identification of incentives for industrial participation in the OSDC, and analysis of similar facilities was initiated in August 1981 and completed in June 1983. The participants in this phase consisted of AOSTRA, EMR, and nine oil sands lease holders, all of whom shared equally the Phase II total cost of $398,742.

Phase III of the project, including site selection, scope finalization, design and costing, and support facilities studies was completed in June 1984, at a cost of $482,411. The participants and their

respective participation percentages in this phase were: AOSTRA (55%), EMR (25%), Chevron Canada Limited (5%), Nova, an Alberta Corporation (5%), Petro-Canada Inc. (5%), and Shell Canada Resources Limited (5%).

The OSDC design assembled in Phase III consisted of a core facility capable of servicing two satellite plants; the UMATAC dry retorting process at a capacity of 90 t/hour, and a solvent extraction process at a capacity of 10 - 20 t/hour. The capital cost for this core facility was estimated at $23.4 million.

As a result of the current depressed oil prices and the associated downturn in oil sands research and development by industry, AOSTRA has scaled-down the scope of the OSDC to accommodate demonstration of the UMATAC dry retorting process only. However, the core facilities could be expanded as required to accommodate future projects such as solvent extraction.

Current activities on the OSDC project are being directed towards using minimum (or existing) facilities and providing industry with incentives to participate in its operation or a specific demonstration project.

5.6 Overburden Dredging Pilot at Syncrude

AOSTRA, recognizing the potential of dredging for lowering stripping costs, and increasing reserves, commissioned two studies by H.G. Stephenson in 1977 and 1978 at a cost of $80,000. The results indicated that dredging had the highest potential for cost savings in overburden stripping.

In 1980 through 1983, AOSTRA funded laboratory studies by Dr. M.B. Dusseault of the Universities of Alberta and Waterloo, at a cost of $40,000 which explored problems inherent in dredging high fines overburden such as the Clearwater clays and shales.

In 1982, AOSTRA and Petro-Canada Exploration Inc. funded a program costing $370,000 on a 50:50 basis at the Delft Hydraulic Laboratory, Delft, Holland, using a laboratory scale dredge to dig and pump samples of oil sands and clays from the McMurray area.

In 1983 and 1984, AOSTRA maintained dialogue with Syncrude Canada Limited and others to stimulate some measure of field testing which all earlier work indicated as mandatory prior to commercialization.

In 1985, AOSTRA and Syncrude conducted a field test consisting of dredging and disposing of overburden at Syncrude's Lease No. 17. The focus of the test was on the disposal of the dredged material, which earlier laboratory work had indicated may present significant problems.

The 1985 test on the Syncrude site employed a sixteen inch dredge equipped with additional digging and pumping power. The tests were conducted from mid-August to the end of September, and involved digging and disposing of 7000 Bench Cubic Meters (BCM) of overburden material.

The tests proved that the overburden could be dredged and that the spoil material exhibited more positive geotechnical properties than anticipated.

The 1985 program cost $2.3 million, with AOSTRA funding $1.0 million.

A further test is planned in 1986, moving more overburden and testing more pumping and disposal parameters. A short test on oil sand dredging is also tentatively scheduled.

Positive results from the 1986 program could lead to a full scale dredge test, commencing in 1987 in Syncrude's expansion mine area.

5.7 Dravo Solvent Extraction Process

Dravo Engineers, Inc. have developed a continuous, percolation-type solvent extractor for the extraction of bitumen from mined oil sands. Dravo undertook, for AOSTRA, to prepare a design and cost estimate for the construction and operation of an extraction pilot plant, based on 200 t/day ore feed of 11.6 wt% bitumen. Dravo also prepared a similar, extraction-only conceptual commercial design, based on a 66,667 t/day feedrate.

The project, which was carried out by Dravo in 1985, for a total cost of $150,000, was funded wholely by AOSTRA. AOSTRA has since initiated an in-house comparative economic evaluation of the Dravo and hot water extraction processes, as integrated in a mining/extraction/upgrading facility. It is expected that the evaluation will be completed by mid-1986.

6 Upgrading Program

6.1 Upgrader Demonstration Project

A major conclusion of the Heavy Oil Upgrading Study was that certain high conversion hydrocracking processes offered better economic potential than commercial coking processes currently in use. This study, undertaken by AOSTRA, the Federal Department of Energy, Mines, and Resources, and a group of industrial companies, was completed in 1983. The prediction of improved economic potential for high conversion hydrocracking processes was based on estimates of higher liquid yield and lower costs. These processes have demonstrated this potential in laboratory and pilot plant tests, but to date, none of these processes are in commercial operation at high conversion levels. Conversion is the measure of the disappearance of non-distillable residue material through conversion to distillable liquid products. Bitumen typically contains over 50% residues. High conversion processes would convert over 85% of this residue to distillable products.

AOSTRA, Energy Mines and Resources Canada, and the majority of companies involved in the Heavy Oil Upgrading Study initiated the Upgrading Demonstration Project (UDP). The intent of this project is to reduce the risk of using attractive upgrading processes commercially through demonstration tests.

The first phase of the UDP determined what would be an adequate demonstration of commercial viability, what test facilities are required, what processes should be tested and what test facilities are available. This phase, which was completed in 1985 at a cost of $119,375 concluded that feed tests of Alberta feedstocks in specific licensors' test facilities could demonstrate commercial viability of selected upgrading processes.

In Phase II, which was completed in March 1986, three specific tests were defined. These include: CANMET Hydrocracking licensed by Petro-Canada Exploration, Inc. to be tested at the semi-commercial demonstration unit in Montreal, the Combi-Cracking Process (VCC) licensed by VEBA OEL Aktiengesellschaft to be tested at VEBA OEL's demonstration plant in West Germany, and high conversion H-Oil licensed by Hydrocarbon Research, Inc. to be tested at the process demonstration unit in New Jersey.

In Phase II, the scope of work was defined for each of the three tests, logistics of feedstock supply developed, costs estimated and legal agreements negotiated.

Participants in the project were invited in February 1986 to join Phase III to carry out one or more of the proposed tests. AOSTRA has agreed to pay 50% of the costs. Licensors have indicated a willingness to share some of the remaining costs. At this time, due to severe budget constraints because of low oil prices, support from industry is low. AOSTRA is currently reviewing options with licensors and potential users to redefine test proposals to demonstrate the upgrading technologies needed for future commercial projects.

6.2 AOSTRA-Industry Upgrading Residue Utilization Project

The AOSTRA/Industry Upgrading Residue Utilization Study was initiated late in 1982, and presently includes AOSTRA, the Federal Department of Energy, Mines and Resources, and eight industrial companies. The study's objective is to identify, evaluate, and eventually test the most promising technologies for the economic and environmentally acceptable utilization of residues, such as pitch or coke, produced during the upgrading of bitumen and heavy oil.

Phase II, initiated in January 1984, is a detailed technical and economic assessment of selected utilization technologies. From these technologies promising alternatives were identified for the utilization of residues. Detailed evaluations were performed on 27 different plants encompassing various upgrading processes, residues and utilization technologies.

The Phase II final report was issued in December 1985. Based on the report's conclusions and recommendations, pilot tests on selected residues and utilization technologies are currently being evaluated for a Phase III undertaking. The Phase III scope of work, budget, schedule, and agreement will be completed by November 1986, at which time the participants will make their selection with respect to their participation in Phase III options.

Total costs to date amount to $1,870,000 of which AOSTRA has provided $900,000.

6.3 AOSTRA-Gulf Donor Refined Bitumen Project

The Donor Refined Bitumen (DRB) Process is a method of upgrading which involves hydrogen transfer to bitumen from process derived donor solvent. Based on the success of the initial development by Gulf Canada Limited at Sheridan Park, Ontario and the potential advantages of lower costs, simplicity and improved operability, AOSTRA has shared the development costs with Gulf since 1983. AOSTRA funded 50% of the $3.15 million cost for two phases of pilot plant research which have been recently completed at Sheridan Park.

AOSTRA is now working with Gulf and ASVAHL to demonstrate the process at a research refinery in France. ASVAHL, an acronym for "Association Pour la Valorisation des Huiles Lourdes" or the Association for Upgrading Heavy Oil, has Institut Francais du Petrole (IFP) and the French oil companies ELF and Total as equal partners. ASVAHL has built a research refinery which includes all the DRB process elements: fractionation, visbreaking, and hydrotreating. Over 2000 m^3 of Athabasca bitumen has been shipped to France in preparation for a major feedstock test program in the fall of 1986.

The conduct of the process demonstration in the existing facilities at ASVAHL is the most cost effective method for commercialization of this technology.

In this venture, the three parties will provide equal contributions to the development.

6.4 Bitumen Water Transportation Study

Concern about the availability of sufficient diluent to permit pipeline transportation of increasing amounts of bitumen and heavy oil to market renewed interest in the concept of using water as a low viscosity carrier. In 1984, a group of 11 companies, the Federal Department of Energy, Mines, and Resources, and AOSTRA initiated a project to examine the concept of pipeline transportation of bitumen and water mixtures. The first phase cost $91,790 was shared equally by all participants. This preliminary phase reviewed the feasibility and economics of the concept.

Phase I concluded that the transportation of emulsions was possible and in certain instances had economic advantages.

A second phase, to work with developers of emulsion pipelining technology to demonstrate the concept, was proposed in December 1985. Due to the costs involved and coincident timing with the drop in oil prices, this proposal did not receive sufficient industrial support to proceed.

6.5 Toyo Engineering Corporation

In 1985, AOSTRA agreed to fund Toyo Engineering Corporation (Japan) $196,500-US to demonstrate the continuous, steady state operation of HSC/ROSE® process for upgrading Cold Lake heavy oil. The HSC/ROSE® process (high conversion soaker cracker/residuum oil supercritical extraction) is a heavy oil cracking/deasphalting process that combines moderate thermal cracking by HSC and solvent extraction of the HSC residue by ROSE.

A 100 kg/hour pilot test of the HSC process was carried out in January 1986 for a total of 118 hours continuous operation. Preliminary results indicate that upwards of 66 wt% of the vacuum bottoms feedstock can be converted to -500°C products without significant coke build-up. Residue from the HSC process will be shipped to Kerr McGee (USA) in the spring of 1986 for extraction tests in its 7 kg/hour pilot test facility. A final report containing technical performance data and commercial economics for a 3200 m^3/day plant (whole bitumen feed) is expected by the fall of 1986.

7 University Program

7.1 Professorships

In the past eleven years, AOSTRA has appointed eleven professors to Professorships at Alberta universities to carry out advanced research on oil sands problems. The term of appointment is three years renewable for a further term of two years. The incumbent professors may also apply for additional funds for specific research projects.

The current incumbents are involved in the following research projects:

i) Dr. J.W. Costerton of the University of Calgary will be investigating the use of bacteria ultramicrocells as a method of preventing coning and improving flow paths of fluids in high permeability zones in conventional and heavy oil reservoirs.

ii) Dr. L.G. Hepler of the University of Alberta is continuing his investigation of clay/oil/water systems encountered in many aspects of the oil sands industry and is also measuring specific heats of various components of oil sands and heavy oil deposits.

iii) Dr. O.P. Strausz of the University of Alberta is continuing the investigation of the chemistry of Alberta oil sands bitumens, with particular emphasis on the heavier fractions.

iv) Dr. E.L. Tollefson of the University of Calgary continues the investigation of desulfurization of coke and the relative fuel values of some constituents of oil sands.

These professors devote approximately three-fourths of their time to oil sands research. The total funds committed to date for the Professorship program is $3.6 million.

7.2 Graduate Scholarships and Fellowships

Post-graduate scholarships and fellowships have been made available over a nine-year period for oil sands research at the University of Alberta, the University of Calgary, and the University of Lethbridge. Current award holders are identified in the following lists. The scholarships are for a maximum period of two years and the research carried out will normally lead to either a Masters or Doctoral degree. Fellowships are intended to assist post-doctoral scientists in furthering their research training. Many of these individuals will eventually enter the industrial research sphere.

University of Alberta

Branco, P.	Macrides, C.
Coskuner, G.	*McIntyre, D.D.
Decker, R.M.	Proctor, M.L.
Dimitrakopoulos, R.G.	Sarma, H.K.
Kasperski, K.L.	Semple, K.M.
Khorasheh, F.	*Singh, R.
*Law, H.S.	Tortika, W.S.
Madelay, R.A.	Treit, J.D.

University of Calgary

Abercrombie, H.J.	McBain, C.M.
Chung, K.H.	*McKinley, V.L.
Dyhe, C.G.	Nghiem, L.H.
Gorecki, R.C.	Peacock, D.
Johnson, S.E.	Sibbald, L.A.
Kirk, M.J.	Yee, C.T.
MacLeod, F.A.	

* Fellowship

7.3 University Research Program

AOSTRA continues to support various oil sands and heavy oil-related research projects at Canadian universities. The university research program covers many areas of practical interest ranging from fundamental research to new process development for recovery and upgrading of bitumen and heavy oil. The budget in 1985/86 for support of research in Canadian universities amounted to approximately $2.8 million. Brief descriptions of the projects carried out in 1985/86 follow:

1. Dr. H. Alper of the University of Ottawa is continuing his research for new, mild, and economical methods for extraction of sulfur from bitumen. A total of $68,070 over 18 months was made available to Dr. Alper for this study.

2. Dr. D.W. Bennion and Dr. R.G. Moore of the University of Calgary are continuing their extensive investigation of combustion in oil sands and the low temperature oxidation of bitumen. These researchers have been funded over a period of 11 years for a total of $1,918,764.

3. Dr. N. Berkowitz of the University of Alberta is continuing his study of bitumen extraction from oil sands by using supercritical gas in H-donor systems. Funding of this project amounts to $96,740 over two years.

4. Dr. P.M. Boorman of the University of Calgary completed his investigations of heterogeneous catalytic desulfurization of bitumen. This work, begun in 1976, was funded to a total of $500,031.

5. Dr. B.D. Bowen and Dr. S. Levine of the University of British Columbia have been studying the stabilization of emulsions by fine particles and clays. This project was funded to the amount of $73,024 for a period of 18 months.

6. Dr. R.M. Butler of the University of Calgary is investigating heat and mass transfer mechanisms important to processes of in situ recovery of bitumen. Funding of Dr. Butler's work amounts to $582,500 over four years.

7. Dr. R.G. Cavell of the University of Alberta is applying Secondary Ion Mass Spectrometry (SIMS) to study the interaction of polar organic and inorganic molecules with mineral surfaces such as those found in tailings of the hot-water process. The amount of funding is $151,410 for a three-year period.

8. Dr. F.S. Chute and Dr. F.E Vermeulen of the University of Alberta have been measuring electrical properties of oil sands, developing physical models of electrical heating processes, and evaluating the use of electrical power for selective heating of oil sands. Their research is funded to the amount of $537,663 over a period of nine years.

9. Dr. I.G. Dalla Lana and Dr. M.R. Gray of the University of Alberta are characterizing kinetics of refining processes in terms of the functional groups of the components of bitumen feedstock. This two-year project has been funded to the amount of $150,000.

10. Dr. J.E. Desnoyers of the University of Sherbrooke is studying phase equilibria and other properties of oil-water microemulsions, with the objective of using microemulsions for extraction of bitumen and heavy oil. Funding for this work amounts to $398,170 over seven years.

11. Dr. F.A.L. Dullien of the University of Waterloo is investigating pore structure, rock-fluid interactions, and two-phase flow behavior in cores obtained from the Pembina Cardium A-Pool. This project has been funded to the amount of $47,492 for two years.

12. Dr. M.B. Dusseault of the University of Waterloo is using a computer to model in situ geomechanics. This project is funded to the amount of $10,000 for one year. Other projects amounting to $69,551 over four years are geotechnical studies of how a dredge might perform if used to remove overburden at a mining site and of the strength of basal clays of the McMurray formation.

13. Dr. S.M. Farouq Ali of the University of Alberta is studying the use of small amounts of carbon dioxide gas to improve the waterflooding process for recovery of Alberta light oils, developing new methods of mobility control that will improve recovery of heavy oil or bitumen from the Athabasca and Lloydminster deposits and developing a computer program to model formation fracturing and recovery during steam-injection operations. Funding of these projects amounts to $979,470 over eight years.

14. Dr. J.E. Gillott of the University of Calgary is investigating the changes in strength, dimensions, permeability, and bonding characteristics of oil well cements after hydrothermal treatment in the presence of formation fluids and drilling muds. This is a seven-year project amounting to $238,349.

15. Dr. L.G. Hepler of the University of Alberta, previously of the University of Lethbridge, has been doing research for many years on colloidal and thermodynamic properties of various clay, oil, and water systems and is also measuring specific heats of oil sands and other parameters important to the in situ recovery processes. Funding has amounted to $787,004 over ten years.

16. Dr. T.R. Hsu of the University of Manitoba is developing a computer program to model high-velocity fracturing of oil sand and doing laboratory experiments to develop a process that will generate communicating paths between nearby wells. This three-year project costs $196,300.

17. Dr. I.E. Hutcheon of the University of Calgary is studying the dissolution and precipitation of minerals that occur in thermal processes for recovery of bitumen. Funding of this five-year project amounts to $398,850.

18. Dr. J.B. Hyne of the University of Calgary is studying chemical reactions that cause gas to be produced as a reservoir is steamed. The cost of this two-year project will be $198,270.

19. Dr. F.W. Jones and Dr. J.S. Rogers of the University of Alberta are developing an improved meter to measure tilt of the surface induced by a recovery process. This instrument is potentially useful for following the progress of in situ recovery processes. This seven-year project costs $325,268.

20. Dr. G. Karim of the University of Calgary is doing experiments to model ignition and quenching of a flame that would occur in an in situ combustion process. This research has been funded to a total of $238,622 since 1976.

21. Dr. H.R. Krouse of the University of Calgary is completing a project to develop analytical procedures that determine the thermal history and sources of fluids produced by thermal recovery processes. A mass spectrometer is used to measure the amount of various isotopes of oxygen, carbon and sulfur found in some components of the fluids. Funding of this project amounted to $412,800 over eight years.

22. Dr. R. St J. Lambert of the University of Alberta is studying the tectonic setting and history of the oil sands deposits by a quantified analysis of the subsidence history of the Cretaceous rocks in the western Canadian sedimentary basin. Funding for this two-year project amounted to $78,260.

23. Dr. P. Lancaster of the University of Calgary is developing computer algorithms for problems in geophysical tomography and in the application of inverse scattering methods. A "peeling" algorithm is used to improve resolution obtained in presentation of results of seismic studies. Funding of this one-year project amounts to $38,810.

24. Dr. B.C.Y. Lu of the University of Ottawa is doing laboratory experiments to measure phase equilibria of mixtures of water and bitumen for conditions obtained in steaming processes. Also, Dr. Lu is examining the internal consistency of existing data on gas solubilities in bitumen which are available to AOSTRA. Funding amounts to $176,900 over four years.

25. Dr. N.R. Morgenstern and Dr. J.D. Scott of the University of Alberta are measuring the strength, deformability, and permeability of oil sands at high temperatures and pressures that are found in in situ thermal processes. This work has been funded to a total of $627,225 over a five-year period.

26. Dr. E. Nyland of the University of Alberta is developing and testing algorithms that interpret signals received by geophones and that monitor and locate sources of microseisms induced by in situ processes. This five-year project cost $391,864.

27. Dr. S.G. Pemberton of the University of Alberta is studying the ichnological microdynamics of the Athabasca oil sands. Traces of the fossil workings of worms provide good paleontological control and predictive capabilities beyond the borehole. Funding for this two-year project is $136,265.

28. Dr. L.W. Reeves of the University of Waterloo is investigating the use of nuclear magnetic resonance spectroscopy to determine physical and chemical properties of samples of oil sands and bitumen. This project is costing $30,000 for two years.

29. Dr. R.S. Roche of the University of Calgary is investigating the kinetics of the pyrolysis of bitumen. Dr. Roche is perfecting his analytical procedure, non-isothermal programmed pyrolysis-mass spectrometry (NIPPY-MS), for identifying the thermo-oxidative changes in asphaltenes and other components of bitumen. Samples of produced fluids from in situ combustion pilots are being studied. This project has been funded to the amount of $1,027,730 over ten years.

30. Dr. T.J.T. Spanos of the University of Alberta is developing mathematical expressions that describe flow of mixtures of oil and water through sand, that describe the gravity drainage process, and the propagation of sound through an oil sands deposit. This research cost $208,799 over five years.

31. Dr. O.P. Strausz and Dr. D.S. Montgomery of the University of Alberta have been conducting several continuing research projects involving different aspects of the chemistry of bitumen. One project is a detailed investigation of the asphaltene and resin fractions of bitumen. Another is the characterization of olefins present in Athabasca bitumen and the Cretaceous heavy oils in Alberta. Total funds spent and committed in the period 1977 to 1986 amount to $2,716,693.

32. Dr. W.Y. Svrcek and Dr. A.K. Mehrotra of the University of Calgary are measuring the solubilities of gases in bitumen and the viscosities of the resulting gas-bitumen solutions. Total funding since 1976 has been $584,647.

33. Dr. E.L. Tollefson of the University of Calgary is investigating the technology and economics of desulfurizing the coke produced from bitumen upgrading operations. This research cost $618,370 over seven years.

34. Dr. J.K.S. Wan of Queen's University is investigating the use of microwave heating of dilute catalysts to hydrocrack fractions of bitumen. Also, Dr. Wan is improving his similar process developed earlier for AOSTRA to generate olefins from methane and other alkanes. Total funding is $420,104 for five and one-half years.

35. Dr. N.C. Wardlaw of the University of Calgary is investigating rock-pore properties in carbonate and sandstone reservoirs important to enhanced oil recovery processes. This project is funded for $367,384 over a four-year period.

8 AOSTRA-Alberta Research Council Program

AOSTRA continues to support several major research programs at the Alberta Research Council (ARC). These programs are described below.

8.1 Oil Sands Laboratory Research

This is the final year of the five-year agreement between AOSTRA and ARC for conducting a joint oil sands research program at ARC's Oil Sands Research Laboratories with the aim of developing economically viable steam-based thermal in situ recovery processes through an integrated and balanced laboratory research plan. In 1985/86, a total of approximately $5.25 million was expended for the program. AOSTRA contributed 60% (equivalent to $3.15 million) of the total cost and ARC the remainder.

Some of the most notable accomplishments achieved during the year are as follows:

a) Further improvement has been made to define the injection strategy and process conditions for recovery of bitumens under Cold Lake reservoir conditions with dissolved gas. It was found that the steam and carbon dioxide process or the steam and methane process was more effective in producing oil when using slug injection instead of co-injecting carbon dioxide with steam. The overall conclusions were that the dissolved gas content of oil sands has a substantial effect on recovery processes and that different injection strategies are required for live and dead oil conditions.

b) Field sampling, experimental techniques, and computer codes are being developed to monitor, predict, and control formation and well damage caused by injection-fluid/mineral reactions at high temperature and pressure conditions. State-of-the-art methods for measuring and predicting needed data are in place.

c) Directing steam and injection fluids into desired areas of a formation to maximize the bitumen recovery is an important goal but a difficult problem to solve. In working towards a solution, researchers have identified the necessary flow regime with which in situ foams in porous media can be generated and used to block off certain undesirable areas of the formation.

d) Extensive state-of-the-art property data are obtained and predictive correlations are also developed. The research staff has been working on quantitative relationships describing the properties of bitumen containing injected fluids, under the high temperature and pressure of in situ recovery conditions. Experiments during the year were successful in measuring quantitative values for the relative permeability of bitumen, water, and gases in core samples. Experiments were also conducted to develop quantitative relationships to predict viscosities and pressure-volume-temperature relationships of bitumen/gas systems.

e) The computer tomography equipment, acquired from the University of Alberta Hospital in Edmonton and the Foothills Hospital in Calgary, was commissioned in 1985. The amount of sand, water, and oil inside a field core can now be determined and experiments in observing the displacement of heavy oil and bitumen by displacing agents may be performed.

f) At the end of the five-year program, the researchers have completed 14 assessment reports in various major segments of the program as an integrated technology package.

Since its inception in 1981, the AOSTRA/ARC joint oil sands research program has developed a technology and expertise base composed of both trained personnel and advanced technical hardware. Both data and process concepts developed in the program are being applied in the field. To facilitate transfer of technology to field applications, the joint program is being restructured into two programs. A "Core Program" and a "Strategic Program", will for the next five years, concentrate on the following:

The Core Program will:

- focus on regional generic problems;
- evaluate and verify novel concepts;
- investigate fundamental reservoir mechanisms;
- support long-term technology development.

The Strategic Program will:

- be mission-oriented and focus on site specific field problems;
- further develop promising process concepts from the core program and the university program;
- focus on process development for field application;
- support short- and medium-term needs;
- evaluate innovative process concepts from other sources.

In support of these new thrusts, new programs are being developed with important contributions from Industry/ Access member companies, from field pilot operations, and from AOSTRA/ARC staff members.

8.2 Regional Geological Study

AOSTRA and ARC jointly supported a project to continue the regional geological work from April 1, 1984 to September 30, 1985. The total cost of carrying out the 18-month project amounts to $1,333,333 of which AOSTRA paid 60% and ARC the remainder. The project was further extended for six months and concluded on March 31, 1986. AOSTRA paid its 60% share of the total cost (approximately $270,000) for the extension. The project resulted in the completion of seven technical reports focused on the Peace River, Wabasca, Cold Lake, Lloydminster, Grosmont, Mississippian, and South Athabasca deposits.

Since late 1979 the regional geological investigations of Alberta's oil sands and heavy oil deposits have produced an extensive data base and geological expertise unique both within and beyond Alberta. Furthermore, the staff which has been assembled through this program has provided significant technical contributions to geological problems associated with a large number of AOSTRA-supported pilot projects.

To capitalize upon the existing geological expertise and data base, a new and strongly-focused five-year oil sands program is being developed.

A Joint Research Program will focus on resource characterization and detailed geological reservoir studies. Funding will be provided on an equal, tripartite basis by AOSTRA, Alberta Department of Energy, and ARC.

A Strategic Research Program has been designed to address specific proprietary geological concerns of AOSTRA in areas of resource evaluation, pilot siting, operational strategy, and process-reservoir compatibility. Funding will be 100% by AOSTRA.

8.3 Hydrocarbon Upgrading Project

The objective of this project is to develop a research capability in Alberta on upgrading of bitumen and to do bench-scale and pilot-scale experiments that develop promising processes discovered in other AOSTRA-supported research. The project is supported equally by AOSTRA and the Alberta Research Council, with an annual budget of $1.5 million. This is the second year of the three-year program which was started in June 1984.

During the second project year, emphasis was placed on the evaluation of a small addition of coal to bitumen in a so-called co-processing mode, evaluation of Ni-soaps for hydroprocessing bitumen, testing of a concept of regenerating spent catalyst, and constructing a tubular reactor system for evaluating processes in a continuous mode.

8.4 Sample Bank

AOSTRA continues to support up to 2.4 person years each year for the Sample Bank to carry out its prime function of providing "standard" oil sands, bitumen, and other related samples to research workers around the world. In the year ending March 1986, 149 shipments were made. A total of 219,024 kg were shipped and generated a total income of $168,533.

9 Programs at Other Research Organizations

9.1 British Columbia Cancer Foundation

AOSTRA provided the Carcinogen Testing Laboratory of the British Columbia Cancer Foundation with $125,000 over a two-year period to evaluate the use of mammalian cells in genotoxicity testing of oil sands process streams and related materials. Samples were collected from various AOSTRA-supported pilot projects and assayed for their capacity to induce chromosome and DNA damage in Chinese hamster's ovary cells and human skin fibroblasts, respectively. The objective of the study is to develop a relevant system for making human carcinogen risk assessments.

The project was completed in December 1985. The final results, in general, do not suggest that any of the process streams will pose any human health hazard in the immediate work environment or in the environment at large.

9.2 British Columbia Research Council

AOSTRA and the British Columbia Research Council have agreed to jointly fund a research project for developing and preparing a new low-cost aminopolysaccharide obtained from readily available cellulose as possible water thickening agents which may be used as mobility control materials for enhanced oil recovery.

AOSTRA expended a total of $67,000 which is one-half of the cost of carrying out the project. The project was completed in December 1985 and the results obtained were not as good as originally anticipated. It appeared the proposed synthesis route was too severe and the cellulose was degraded.

9.3 Syncrude Canada Limited

AOSTRA and Syncrude Canada Limited have jointly funded a research project to develop a computerized regional Air Quality Prediction System (AQPS) which will forecast, up to eight hours in advance of real time, the possibility of emissions from the Syncrude plant which exceed the limit as specified by the provincial air quality standards and prevent any violations.

Syncrude is the operator of the project which is anticipated to be completed by June 1986. The total cost of the project is $2,392,200 with AOSTRA to pay one-third of the project cost ($797,400).

9.4 Petroleum Recovery Institute

During the current year AOSTRA continued support of the research program at PRI by matching industry membership contributions. The AOSTRA grant for the 1985-86 period totalled $1,125,562.

PRI currently has five major research activities underway in the area of Enhanced Oil Recovery Technology. Results of this work are available to industry as well as to AOSTRA for potential application.

10 Inventors Grant Assistance Program

The Inventors Grant Assistance Program (IGAP), first implemented in 1983, was continued during fiscal 1985. The purpose of IGAP is to encourage and assist Alberta inventors to develop their inventions beyond the idea and concept stage so that conventional funding for commercialization may be obtained. A maximum of $50,000 may be awarded to individuals or companies for use in developing inventions. AOSTRA does not earn any use rights to the inventions and the only requirement on the part of the inventor is a commitment to use the funds in the development of the invention and to supply both accounting and technical reports to AOSTRA.

During fiscal 1985, sixteen applications were received. Only two awards were made and one application is still under review. Details of the awards made are as follows:

IGAP Recipient	Amount of Grant	Activity Supported
C. Ayasse	$ 8000	Patenting EOR chemical process-1
C. Ayasse	$ 8000	Patenting EOR chemical process-2

11 International Program

11.1 AOSTRA/China Relationship

AOSTRA has been very active over the past year in efforts to strengthen its relationship with the People's Republic of China. AOSTRA's objective is to assist the Alberta service and equipment industry in the petroleum sector to develop business opportunities in China. A three-man delegation was sent to China in April 1985, while China responded with a delegation which traveled to Alberta in June.

While in China, AOSTRA signed technology cooperation agreements with the Research Institute of Petroleum Exploration and Development (RIPED) and the Liaohe Petroleum Exploration Bureau. On June 18, 1985, AOSTRA and the Xingjiang Petroleum Administration Bureau signed an agreement in Edmonton.

As one of the initial steps in fulfilling the terms of its agreement with RIPED, AOSTRA is devoting an entire technical session of the 1986 conference on "Advances in Petroleum Recovery and Upgrading Technology" to Chinese heavy oil recovery experience and technology.

11.2 AOSTRA/Brazil Relationship

AOSTRA played an active role together with the Federal Department of Regional Industrial Expansion (DRIE) and Alberta Economic Development in organizing and participating in a seminar and workshop presented by Canadians to PETROBRAS in Brazil to demonstrate the depth of Canadian technology in the petroleum and natural gas sector. Follow-up visits to Alberta have been made by PETROBRAS staff and PETROBRAS is shipping samples of oil shale fines and filter cake for testing using the Taciuk process.

11.3 AOSTRA/United States Relationship

The memorandum of understanding signed by the Department of Energy in the United States, the Department of Energy, Mines and Resources (Canada), the Department of Mineral Resources of the Province of Saskatchewan, and AOSTRA is being actively pursued by all parties. Joint projects have been initiated on remote sensing, analytical methods and steam additives. The association continues to be fruitful and meetings are held regularly to conduct business.

12 Training Programs

AOSTRA continued its highly successful program of providing employment for up to 21 university summer students, who are mainly employed on research projects conducted by university researchers. In addition, up to six co-op students are employed on a year-round basis for individual periods of four to eight months.

13 Industrial Post-Doctoral Fellowship Program

In 1983 AOSTRA implemented its industrial Post-Doctoral Fellowship Program which was designed to assist the transition of post-doctoral researchers from an academic to an industrial environment. During the two-year term of the award, valued at $22,500 per year, the AOSTRA Industrial Fellow conducts a research project in the laboratory of the sponsoring company which provides the space, equipment, and support personnel required for the proper conduct of the research. Dr. N.S. Srinivasan, the current holder of the award, is studying the consequences of the presence of natural surfactants released from bitumen by the hot water process at the Syncrude Canada Limited laboratories in Edmonton.

14 Methods for Acquiring AOSTRA Technology

All technology developed from projects funded by AOSTRA is available under fair business terms.

14.1 Completed Projects

For those projects which are completed, a potential purchaser of information or use rights may negotiate with AOSTRA to arrive at a suitable acquisition price. This price is dependent upon the usefulness of the technology rather than the cost of developing it.

14.2 Active Projects

Technology may also be accessed on an ongoing basis from a currently operating project by joining the project as an active participant. The minimum basis of participation is a 12.5% interest with the participant having voting rights and a world-wide license fee-free right to use the technology. An alternative approach is through the consultive participant role in which the participant pays less than 12.5% of the cost and does not have voting privileges but does, however, acquire technology use rights.

14.2.1 University Research Projects

Over the past year, a total of ten companies have been accessing the results from the university projects. These industry participants jointly pay more than 24% of the cost of the university activity. Under this access program, the companies earn use rights and have the privilege of visiting the various laboratories and consulting with the researchers.

14.2.2 Joint AOSTRA/ARC Laboratory Program

There are currently four companies participating in this program. This program provides for the use of the technology without fee and for meaningful input into the direction and content of the research work.

The companies have been actively involved in this research and have been providing useful advice to those conducting the experimental work.

14.2.3 The Data Base Management System

As outlined in Section 1.8, the ADBS provides full data storage, access, and reporting for in situ pilot projects. Five companies operating six projects are currently using the system. Licensing arrangements are made between AOSTRA and individual companies with system charges being directly related to the volume of data and amount of use. AOSTRA will arrange for a "live demonstration" of system capabilities for interested companies.

15 Ten Year Review

Late in 1983, AOSTRA selected a steering committee and appointed a technical review manager and established an office to conduct an independent technical review of all of AOSTRA's activities since its formation in 1975. This resulted in the preparation, mainly by AOSTRA staff and consultants familiar with AOSTRA activities, of 46 synopsis reports summarizing in concise format the technology which AOSTRA had developed. The second phase of the technical review consisted of an audit of each project or technology area by a team of two independent consultants chosen for their knowledge and impartiality. A total of 44 technical audits were conducted during the period October 1984 and March 1985. The results and recommendations arising from these confidential audits are presently being examined by AOSTRA with a view to increasing AOSTRA's relevance, success, effectiveness, and efficiency.

16 Publications, Conferences, and Workshops

AOSTRA continued to publish quarterly the AOSTRA Journal of Research which concentrates on articles related to bituminous sands, heavy oils, oil source rocks, and tertiary recovery of conventional petroleum (see Report of Activities section for editorial and subscription information).

AOSTRA initiated preparation of an "AOSTRA Technical Handbook on Oil Sands, Bitumens and Heavy oils". This concise summary of theory, technical data, and correlations is designed to be a valuable reference volume for all practitioners working in the oil sands and heavy oil fields. Publication is anticipated in early 1988.

AOSTRA held its annual university access meeting in October. At these meetings, university professors from across Canada who are doing AOSTRA research meet with representatives from industry to discuss their research.

AOSTRA's annual spring seminar was held in Edmonton in June 1985. Highlights of this seminar included papers on underground mining and access, new developments in surface mining and extraction, and upgrading and transportation of bitumen.

During the year, AOSTRA took an active part in the 3rd UNITAR conference in California, and also conducted a fracture workshop in January 1986 which brought together experts from universities, industry, and government in an intensive three-day discussion of the state-of-the-art of fracture technology and where further development is required.

A number of one-day geological workshops related to the geology of Alberta oil sands and heavy oils were conducted by ARC geologists.

17 Economic Analyses

Economics is important in guiding the direction of research and in the development of new and improved technology. AOSTRA has and continues to conduct economic evaluations of proposed and active research projects to determine potential economic viability. During the past year AOSTRA has placed increased emphasis on development of facilities and expertise to handle economic analysis and evaluations.

A computer model has been developed to evaluate the commercial economic potential of in situ processes, using information developed from field test facilities. In a joint program with other Alberta government agencies, AOSTRA will participate in macro energy modeling studies using models developed by the Alberta Research Council and Alberta Energy.

Economic parameters will be used by AOSTRA to assist in the evaluation of applications for funding, in the evaluation and direction of experimental programs, and in the evaluation of results from completed projects in order to establish the potential value of technology available for sale and licensing.

During the past year, economic evaluations completed included: an assessment of the commercial potential of processes being tested at the AOSTRA/Bow Valley/Cold Lake pilot plant; an evaluation of a solvent extraction process developed by Dravo Engineers Inc.; evaluation of alternative methods of pipelining bitumen; and an evaluation of a 1600 m^3/day Taciuk processor.

18 AOSTRA Library and Information Services

Commencing April 1, 1986, the AOSTRA Library and Information Service (ALIS) will come into effect. In addition to providing the previous services offered by the Oil Sands Information Center, ALIS will be responsible for maintaining all AOSTRA confidential reports on an information storage and retrieval system and in providing normal library services to AOSTRA.

While the Alberta Oil Sands Index will be continued as in the past, the Heavy Oil/Enhanced Recovery Index of the enhanced oil section will be restricted to articles on Canada only. In both indices, increased emphasis has been placed on using author abstracts wherever possible. These indices continue to be available in hard copy or can be accessed on-line.

The very popular "Tar Paper" will continue to be published as before.

19 Patents

19.1 AOSTRA Patents

The following patents and patent applications are assigned to AOSTRA:

a) Canadian Patents

Patent No.	Date Issued	Patent Title
1,120,418	Mar 23/82	Process and Apparatus for Thermally Processing Heavy Hydrocarbon-Containing Liquids (W. Taciuk)
1,121,749	Apr 3/82	Apparatus and Process for Recovery of Hydrocarbons from Inorganic Host Materials (W. Taciuk)
1,102,234	Jun 2/81	Gaseous and Solvent Additives for Steam Injection for Thermal Recovery of Bitumen from Tar Sands (D.A. Redford and M.R. Hanna)
1,122,015	Apr 20/82	Process for Microbiologically Leaching Coke (T.R. Jack et al)
1,129,801	Aug 17/82	Alkali Recycle Process for Recovery of Heavy Oils and Bitumens (M.A. Kessick)
1,134,174	Oct 26/82	Two-Phase Wet Steam Flowmeter (D.S. Scott and E. Rhodes)
1,158,458	Dec 13/83	Variable Drive for Pump Jack (D.L. Buckler)
1,120,367	Jun 7/84	Catalytic Sulfur Removal from Hydrocarbons (P.M. Boorman et al)
1,170,444	Jul 10/84	Use of Hydrogen-Free Carbon Monoxide with Steam in Recovery of Heavy Oil at Low Temperatures (J.B. Hyne and J.D. Tyrer)
1,171,382	Jul 24/84	Electrophoretic Process for Separating Aqueous Mineral Suspensions (R.A. Ritter)
1,844,022	Mar 19/85	Use of Surfactants to Improve Oil Recovery During Steam Flooding (E.E. Isaacs and D.R. Prowse)
1,189,444	Jun 25/85	Additive for Inclusion in a Heavy Oil Reservoir Undergoing Steam Injection (J.B. Hyne and P.D. Clarke)

b) Canadian Patent Applications

Application No.	Date Filed	Patent Application Title
379,072	Feb 22/83	Improved Process for Recovery of Residual Bitumen from Tailings from Oil Sand Extraction Plants (E.L. Tollefson and E.S. Hall)
434,617	Aug 15/83	Additive for Inclusion in a Heavy Oil Reservoir Undergoing Steam Injection (J.B. Hyne and P.D. Clarke)
450,276	Mar 22/84	Process for Upgrading Heavy Viscous Oil (Hydrocarbon) (I. Lutz) (Acres Davy McKee DM International, Inc., Houston)

Application No.	Date Filed	Patent Application Title
458,921	Jul 13/84	Two Phase Flowmeter (D.S. Scott and E. Rhodes)
491,238	Sep 20/85	Apparatus for Continuously Separating Particulate Solids from Liquid Suspensions (R.A. Ritter)
491,237	Sep 20/85	Commutator (R.A. Ritter)
491,838	Sep 30/85	Method for Controlling Water Coning in Oil Wells (R.W. Luhning and K.R. Ronaghan)
487,714	Jul 29/85	Microwave Induced Catalytic Conversion of Methane to Ethylene and Hydrogen (J. Wan)

c) U.S. Patents

Patent No.	Date Issued	Patent Title
4,180,455	Dec 25/79	Process for Thermal Cracking a Heavy Hydrocarbon (W. Taciuk)
4,280,879	Jul 28/81	Apparatus and Process for Recovery of Hydrocarbons from Inorganic Host Materials (W. Taciuk)
4,306,961	Dec 22/81	Process for Recovery of Hydrocarbons from Inorganic Host Materials (W. Taciuk - Tar-sand Version)
4,285,773	Aug 25/81	Apparatus and Process for Recovery of Hydrocarbons from Inorganic Host Materials (W. Taciuk - Lloydminster Version)
4,312,234	Jan 26/82	Two-Phase Wet Steam Flow Meter (D.S. Scott and E. Rhodes)
4,271,905	Jun 9/81	Gaseous and Solvent Additives for Steam Injection for Thermal Recovery of Bitumen from Tar Sands (D.A. Redford and M.R. Hanna)
4,406,499	Sep 27/83	Method of In Situ Bitumen Recovery by Percolation (M.A. Kessick)
4,438,218	Mar 20/84	Catalytic Sulfur Removal from Hydrocarbons (P.M. Boorman et al)
4,454,023	Jul/Aug/84	Process for Upgrading a Heavy Viscous Oil (Hydrocarbon) (I. Lutz) (Acres Davy McKee DM International, Inc., Houston)
4,458,759	Jul 10/84	Use of Surfactants to Improve Oil Recovery During Steam Flooding (E.E. Isaacs and D.R. Prowse)
4,487,264	Dec 11/84	Use of Hydrogen-Free Carbon Monoxide with Steam in Recovery of Heavy Oil at Low Temperatures (J.B. Hyne and J.D. Tyrer)
4,501,648	Feb 26/85	Electrophoretic Process for Separating Aqueous Mineral Suspensions (R.A. Ritter)
4,506,733	Mar 26/85	Additive for Inclusion in a Heavy Oil Reservoir Undergoing Steam Injection (J.B. Hyne and P.D. Clarke)
4,574,643	Mar 11/86	Two-Phase Wet Steam Flowmeter (D.S. Scott and E. Rhodes)
4,574,038	Mar 4/86	Microwave Induced Catalytic Conversion of Methane to Ethylene and Hydrogen (J. Wan)

d) U.S. Patent Applications

Application No.	Date Filed	Patent Application Title
06/294,523	Aug 20/81	Variable Speed Pump Jack (D.L. Buckler)
780,399	Sep 26/85	Apparatus for Continuously Separating Particulate Solids from Liquid Suspensions (R.A. Ritter)
780,269	Sep 26/85	Commutator (R.A. Ritter)
784,933	Oct 7/85	Method for Controlling Water Coning in Oil Wells (R.W. Luhning and K.R. Ronaghan)

e) Venezuela Patent Applications

Application No.	Date Filed	Patent Application Title
0067	Jan 21/81	Gaseous and Solvent Additives for Steam Injection for Thermal Recovery of Bitumen from Tar Sands (D.A. Redford and M.R. Hanna)
1933	Oct 31/79	Process and Apparatus for Thermally Processing Heavy Hydrocarbon-Containing Liquids (W. Taciuk)
264	Feb 25/80	Apparatus and Process for Recovery of Hydrocarbons from Inorganic Host Materials (W. Taciuk)
991/80	Jun 10/80	Process for Microbiologically Leaching Coke (J. Zajic/Sullivan)
785/81	May 9/81	Two-Phase Wet Steam Flow Meter (D.S. Scott and E. Rhodes)
108/82	Jan 22/82	Wet Combustion Process (D.W. Bennion, R.G. Moore, and K. Donnelly)
1299/82	Jul 21/82	Use of Hydrogen-Free Carbon Monoxide with Steam in Recovery of Heavy Oil at Low Temperatures (J.B. Hyne/J.D. Tyrer)
1803/83	Nov 11/83	Additive for inclusion in a Heavy Oil Reservoir Undergoing Steam Injection (J.B. Hyne and P.D. Clarke)

f) Mexico Patent Application

Application No.	Date Filed	Patent Application Title
179,758	Oct 24/79	Process and Apparatus for Thermally Processing Heavy Hydrocarbon-Containing Liquids (W. Taciuk)
200,744	Mar 22/84	Process for Upgrading a Heavy Viscous Oil (Hydrocarbon) (I. Lutz) (Acres Davy McKee DM

g) European (EEC) Patents

Patent No.	Date Filed	Patent Title
0-028-666	Apr 6/83	Process and Apparatus for Thermally Processing Heavy Hydrocarbon-Containing Liquids (W. Taciuk) (Belgium, France, Italy, Netherlands, and U.K.)
79,302542.0		(Sweden)
29-65-154.5		(Germany)
81.304752.9	Oct 13/81	Two-Phase Flowmeter (D.S. Scott and E. Rhodes)
84.301888.8	Mar 20/84	Process for Upgrading a Heavy Viscous Oil (Hydrocarbon) (I. Lutz) (Acres Davy McKee DM International, Inc., Houston)

h) Argentina Patent Applications

Application No.	Date Filed	Patent Application Title
279,427	Dec 21/79	Process and Apparatus for Thermally Processing Heavy Hydrocarbon-Containing Liquids (W. Taciuk)

i) Romania Patent Applications

Application No.	Date Filed	Patent Application Title
99095	Oct 30/79	Process and Apparatus for Thermally Processing Heavy Hydrocarbon-Containing Liquids (W. Taciuk)

j) Turkey Patent Applications

Application No.	Date Filed	Patent Application Title
144261	Dec 21/79	Process and Apparatus for Thermally Processing Heavy Hydrocarbon-Containing Liquids (W. Taciuk)

k) Japan Patent Applications

Application No.	Date Filed	Patent Application Title
138227/79	Oct 25/79	Process and Apparatus for Thermally Processing Heavy Hydrocarbon-Containing Liquids (W. Taciuk)
172665/81	Oct 28/81	Two-Phase Wet Steam Flowmeter (D.S. Scott and E. Rhodes)
054111/84	Mar 21/84	Process for Upgrading a Heavy Viscous Oil (Hydrocarbon) (I. Lutz) (Acres Davy McKee DM International Inc., Houston)

19.2 Prior Company Patents (for which AOSTRA has acquired certain licensing rights)

a) Canadian Patents

	Canadian Patent No.	Date Issued	Date Filed	Related U.S. Patent No.	Patent Titles
1.	815802	06-24-69	11-22-66	—	Valve for Obtaining a Sample of the Fluid Flowing in a Pipeline
2.	820083	08-12-69	02-20-67	3366177	Production of Petroleum from Unconsolidated Formations
3.	839042	04-14-70	03-18-66	—	Method of Producing Hydrocarbons from a Subsurface Formation by Thermal Treatment
4.	840211	03-28-70	01-17-66	—	Method of Recovering Hydrocarbons from an Underground Hydro-carbon-Containing Formation
5.	840789	05-05-70	01-17-66	—	Method of Producing Hydrocarbons from an Underground Formation
6.	856023	11-17-70	02-23-68	—	Consolidating Earth Formations
7.	858309	12-15-70	23-68	—	Thermal Secondary Recovery
8.	890741	01-18-72	02-21-69	—	Method of Recovering Hydrocarbons from an Underground Hydro-carbon-Containing Formation
9.	941735	02-12-74	06-01-71	—	Oil Recovery Using Steam and Chemical Drive Fluids
10.	1125649	01-15-82	12-19-79	4234042	Direct Combustion Stimulation of a Producing Well
11.	1118341	02-16-82	09-14-79	4272487	Indirect Thermal Stimulation of Producing Wells

b) U.S. Patents

	Patent No.	Date Issued	Date Filed	Related Canadian Patent No.	Patent Titles
1.	3459265	08-05-69	07-28-67	849320	Method for Recovering Viscous Oil by Steam Drive
2.	3460621	08-12-69	05-22-67	848245	Cyclic Steam Injection and Gas Drive
3.	3464491	09-02-69	12-18-67	848244	Oil Recovery from Formations Containing Channels
4.	3481399	12-02-69	06-10-68	866576	Recovery of Oil by Flashing of Heated Connate Water
5.	3504745	04-07-70	05-08-68	853995	Use of Foams to Prevent Vertical Flow in Tar Sands During In Situ Combustion
6.	3547195	12-15-70	06-19-69	881914	Pyrolitic Plugging of Oil Bearing Formations by Underground Combustion
7.	3729337	04-24-73	04-20-70	—	Production of Petroleum from Unconsolidated Formations
8.	3964547	06-22-76	10-29-74	972679	Use of Tar as a Diverter in Steaming Operations
9.	4147213	04-03-79	—	—	Combustion Air Injection Well
10.	4234042	11-18-80	06-11-79	1125649	Direct Combustion Stimulation of a Producing Well
11.	4272487	—	01-01-79	1118341	Indirect Thermal Stimulation of Producing Wells

Tables

Commitments from AOSTRA Research Fund To March 31, 1986 ($ Millions)

Figure 2

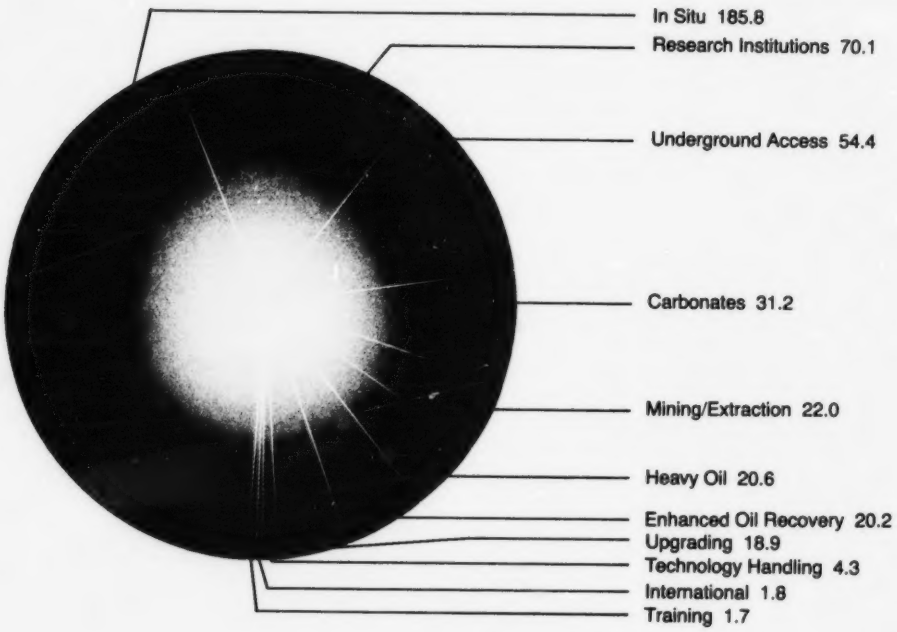

Table 1

Summary of Funds Committed and Disbursed to March 31, 1986

Project	Funds Committed	Prior Years' Disbursements	Disbursements April 1/85 to March 31/86	Balance
Institutional Research				
Alberta Research Council				
— Information Centre	$ 3,716,600	$ 3,192,541	$ 499,620	$ 24,439
— Oil Sands Research Centre	24,193,027	20,260,440	3,015,466	917,121
— Sample Bank	1,551,143	1,096,010	157,118	298,015
— Geological program	3,181,009	2,807,979	309,345	63,685
— Hydrocarbon Program	2,250,000	530,872	797,636	921,492
— Macro Energy Modelling	100,000	—	17,000	83,000
Inventors Assistance Grant	578,119	310,780	117,119	150,220
University Contracts	21,970,491	17,242,292	2,869,781	1,858,418
Professorships	3,589,720	2,924,385	493,856	171,479
Post Doctoral Fellowships	100,000	23,540	22,500	53,960
Scholarships and Fellowships	3,480,000	1,659,948	411,063	1,408,989
Hatch and Associates	383,950	368,272	4,918	10,760
British Columbia Cancer Foundation	125,000	112,106	10,932	1,962
British Columbia Research Council	67,600	49,500	18,100	—
ARC - Access Program	25,000	4,758	3,476	16,766
University Access Program	175,000	147,592	17,975	9,433
Program Planning and Evaluation	500,000	206,161	66,216	227,623
Technical Review	1,084,000	871,396	98,217	114,387
Petroleum Recovery Institute	2,189,252	1,062,005	1,125,562	1,685
Centre for Frontier Engineering Research	25,000	—	25,000	—
Syncrude Canada Ltd.	797,400	555,036	209,085	33,279
Completed Projects	6,098	6,098	—	—
	$ 70,088,409	$ 53,431,711	$ 10,289,985	$ 6,366,713
Mining and Extraction				
Retorting				
— Umatac	$ 15,211,500	$ 11,727,162	$ 2,460,548	$ 1,023,790
— Lurgi	721,820	545,020	—	176,800
Tailings Treatment				
— Syncrude	1,000,000	—	1,000,000	—
Oil Sands Demonstration Centre	425,000	263,933	99	160,968
Suncor/Kruyer Project	915,000	438,679	438,861	37,460
Nova/Husky/Canstar	176,700	—	22,420	154,280
Dravo Engineers Inc.	150,000	—	147,183	2,817
Completed Projects	3,382,128	3,369,863	12,265	—
	$ 21,982,148	$ 16,344,657	$ 4,081,376	$ 1,556,115

Table 1

Summary of Funds Committed and Disbursed to March 31, 1986 (continued)

Project	Funds Committed	Prior Years' Disbursements	Disbursements April 1/85 to March 31/86	Balance
In Situ Oil Sands				
Peace River				
— Shell	$ 76,039,351	$ 63,902,587	$ (1,572,687)	$ 13,709,451
Athabasca				
— Amoco	24,947,108	23,933,154	(47,191)	1,061,145
— Amoco/Petro-Canada	17,108,250	5,854,969	2,013,365	9,239,916
— Canterra Energy Ltd.	30,061,000	21,409,605	3,063,138	5,588,257
— Texaco Canada	1,515,000	1,382,517	84,350	48,133
Cold Lake				
— B.P.	25,596,000	19,210,518	2,692,069	3,693,413
— B.P./Petro-Canada	1,499,250	192,092	281,730	1,025,428
— Suncor - Ft. Kent	400,000	90,380	(9,284)	318,904
— Technica	7,000	5,645	—	1,355
Francis Hankin	457,009	432,100	—	24,909
Mineralogical Study	6,250	1,001	4,881	368
Chevron	374,000	506	272,067	101,427
Water Treatment Study	408,480	285,894	18,987	103,599
Simtech Consulting	25,000	—	18,890	6,110
Completed Projects	7,365,579	7,365,579	—	—
	$185,809,277	$144,066,547	$ 6,820,315	$ 34,922,415
Underground Access				
Athabasca				
— U.T.F. Project	$ 49,281,947	$ 24,118,850	$ 15,691,395	$ 9,471,702
— Total Petroleum	40,000	—	35,372	4,628
— Completed Projects	5,108,264	5,108,264	—	—
	$ 54,430,211	$ 29,227,114	$ 15,726,767	$ 9,476,330
Carbonate Trend				
Buffalo Creek				
— Union Oil	$ 31,185,000	$ 25,796,473	$ 2,234,802	$ 3,153,725
Heavy Oil				
Petro-Canada	$ 14,308,046	$ 13,291,622	$ 316,747	$ 699,677
A.E.C.	6,028,500	5,249,625	422,242	356,633
Completed Projects	239,674	239,674	—	—
	$ 20,576,220	$ 18,780,921	$ 738,989	$ 1,056,310

Table 1

Summary of Funds Committed and Disbursed to March 31, 1986 (continued)

Project	Funds Committed	Prior Years' Disbursements	Disbursements April 1/85 to March 31/86	Balance
Enhanced Recovery Conventional Oil				
Vikor Resources Ltd.	$ 4,000,000	$ 3,533,640	$ (698,262)	$ 1,164,622
PanCanadian Petroleum	1,500,000	450,192	99,194	950,614
Norcen	125,000	98,415	17,664	8,921
Bow Valley, Cold Lake Heavy Oil	11,112,000	6,014,591	2,397,730	2,699,679
Hudson's Bay Oil & Gas	2,462,500	—	1,437,929	1,024,571
Completed Projects	1,030,514	1,029,038	1,476	—
	$ 20,230,014	$ 11,125,876	$ 3,255,731	$ 5,848,407
Bitumen Upgrading				
Residue Utilization Project	$ 1,090,000	$ 556,050	$ 255,100	$ 278,850
Heavy Oil Upgrading Demo Centre	85,000	33,452	44,622	6,926
Bitumen/Water Transporation Study	80,000	15,751	(3,744)	67,993
California Synfuels	414,760	269,994	—	144,766
Gulf Oil - Donor Process	12,377,000	827,000	4,110,225	7,439,775
Murphy Oil	50,000	28,048	16,593	5,359
Acres Davy McKee	80,000	20,000	40,000	20,000
Toyo Engineering	272,310	—	188,847	83,463
Completed Projects	4,424,333	4,424,333	—	—
	$ 18,873,403	$ 6,174,628	$ 4,651,643	$ 8,047,132
Technology Handling				
Data Base Administration	$ 3,243,515	$ 2,476,518	$ 480,930	$ 286,067
AOSTRA Journal	359,773	162,158	149,749	47,866
Patent Costs	500,000	421,419	62,851	15,730
AOSTRA Technical Handbook	100,000	—	219	99,781
Completed Projects	91,865	91,865	—	—
	$ 4,295,153	$ 3,151,960	$ 693,749	$ 449,444
Training Activities	$ 1,695,000	$ 1,269,762	$ 270,129	$ 155,109
International Activities	$ 1,780,800	$ 1,423,705	$ 109,690	$ 247,405
Authority Costs	$ 2,000,000	$ 796,468	$ 471,612	$ 731,920
Totals	$432,945,635	$311,589,822	$ 49,344,788	$ 72,011,025

Table 2

Oil Sands Technology and Research Fund
Eleven-Year Summary
For the years ended March 31

Statement of Revenue
Expenditure & Fund Balance

	1986	1985	1984
Revenue			
Alberta Heritage Savings Trust Fund	$ 50,000,000	$ 50,000,000	$ 54,500,000
Technology Sales	2,156,404	2,056,808	1,988,107
	$ 52,156,404	$ 52,056,808	$ 56,488,107
Expenditures			
Institutional Research			
Alberta Research Council			
— Information Centre	$ 499,620	$ 551,962	$ 495,183
— Oil Sands Research Centre	3,015,466	2,915,270	3,236,077
— Sample Bank	157,118	93,205	134,761
— Geological program	309,345	753,092	642,157
— Hydrocarbon Program	797,636	530,872	—
— Macro Energy Modelling	17,000	—	—
Inventors Assistance Grant	117,119	180,780	130,000
University Contracts	2,869,781	2,994,843	3,152,248
Professorships	493,856	560,622	461,515
Post Doctoral Fellowships	22,500	22,500	1,040
Scholarships and Fellowships	411,063	388,920	383,807
Hatch and Associates	4,918	122,014	246,258
British Columbia Cancer Foundation	10,932	5,466	63,514
British Columbia Research Council	18,100	49,500	—
ARC - Access Program	3,476	514	4,244
University Access Program	17,975	13,861	35,918
Program Planning and Evaluation	66,216	85,675	120,486
Technical Review	98,217	798,958	72,438
Petroleum Recovery Institute	1,125,562	547,690	514,315
Centre for Frontier Engineering Research	25,000	—	—
Syncrude Canada Ltd.	209,085	(26,694)	581,730
Completed Projects	—	—	—
	$ 10,289,985	$ 10,589,050	$ 10,275,691
Mining and Extraction			
Retorting			
— Umatac	$ 2,460,548	$ 2,948,229	$ 2,800,255
— Lurgi	—	—	38,579
Tailings Treatment			
— Syncrude	1,000,000	—	—
Oil Sands Demonstration Centre	99	36,935	218,782
Suncor/Kruyer Project	438,861	378,679	60,000
Nova/Husky/Canstar	22,420	—	—
Dravo Engineers Inc.	147,183	—	—
Completed Projects	12,265	185,171	403,769
	$ 4,081,376	$ 3,549,014	$ 3,521,385

1983	1982	1981 and Prior	Total
$ 39,500,000	$ 28,500,000	$128,949,032	$351,449,032
2,876,477	3,477,561	3,067,855	15,623,212
$ 42,376,477	$ 31,977,561	$132,016,887	$367,072,244
$ 438,174	$ 394,205	$ 1,313,017	$ 3,692,161
2,877,172	2,369,308	8,862,613	23,275,906
261,881	240,975	365,188	1,253,128
521,195	469,740	421,795	3,117,324
—	—	—	1,328,508
—	—	—	17,000
—	—	—	427,899
3,478,549	2,103,367	5,513,285	20,112,073
546,121	472,084	884,043	3,418,241
—	—	—	46,040
184,823	201,760	500,638	2,071,011
—	—	—	373,190
43,126	—	—	123,038
—	—	—	67,600
—	—	—	8,234
26,771	44,159	26,883	165,567
—	—	—	272,377
—	—	—	969,613
—	—	—	2,187,567
—	—	—	25,000
—	—	—	764,121
—	1,622	4,476	6,098
$ 8,377,812	$ 6,297,220	$ 17,891,938	$ 63,721,696
$ 1,532,063	$ 1,348,402	$ 3,098,213	$ 14,187,710
(114,724)	—	621,165	545,020
—	—	—	1,000,000
(33,106)	18,253	23,069	264,032
—	—	—	877,540
—	—	—	22,420
—	—	—	147,183
967,507	957,160	856,256	3,382,128
$ 2,351,740	$ 2,323,815	$ 4,598,703	$ 20,426,033

Table 2

Oil Sands Technology and Research Fund
Eleven-Year Summary
For the years ended March 31

Statement of Revenue
Expenditure & Fund Balance
(continued)

	1986	1985	1984
In Situ Oil Sands			
Peace River			
— Shell	$ (1,572,687)	$ 806,095	$ 3,037,950
Athabasca			
— Amoco	(47,191)	(726,689)	(66,986)
— Amoco/Petro-Canada	2,013,365	5,854,969	—
— Canterra Energy Ltd.	3,063,138	15,199,377	20,228
— Texaco Canada	84,350	1,340,947	41,570
Cold Lake			
— B.P.	2,692,069	3,474,113	878,117
— B.P./Petro-Canada	281,730	192,092	—
— Suncor-Ft. Kent	(9,284)	75,739	14,641
— Technica	—	5,645	—
Francis Hankin	—	26,500	379,905
Mineralogical Study	4,881	—	1,001
Chevron	272,067	506	—
Water Treatment Study	18,987	153,273	133,767
Simtech Consulting	18,890	—	—
Completed Projects	—	39,007	3,862,625
	$ 6,820,315	$ 26,441,574	$ 8,302,818
Underground Access			
Athabasca			
— U.T.F. Project	$ 15,691,395	$ 19,452,415	$ 3,376,745
— Total Petroleum	35,372	—	—
— Completed Projects	—	—	21,192
	$ 15,726,767	$ 19,452,415	$ 3,397,937
Carbonate Trend			
Buffalo Creek			
— Union Oil	$ 2,234,802	$ 4,380,864	$ 2,950,100
Heavy Oil			
Petro-Canada	$ 316,747	$ 1,541,199	$ 993,554
A.E.C.	422,242	349,412	224,545
Completed Projects	—	56,470	25,934
	$ 738,989	$ 1,947,081	$ 1,244,033

1983	1982	1981 and Prior	Total
$ 3,416,430	$ 7,413,067	$ 49,229,045	$ 62,329,900
234,416	1,865,234	22,627,179	23,885,963
—	—	—	7,868,334
6,190,000	—	—	24,472,743
—	—	—	1,466,867
2,429,899	3,231,266	9,197,123	21,902,587
—	—	—	473,822
—	—	—	81,096
—	—	—	5,645
25,695	—	—	432,100
—	—	—	5,882
—	—	—	272,573
(4,283)	3,137	—	304,881
—	—	—	18,890
1,474,768	285,481	1,703,698	7,365,579
$ 13,766,925	$ 12,798,185	$ 82,757,045	$150,886,862
$ 1,289,690	$ —	$ —	$ 39,810,245
—	—	—	35,372
(20,803)	1,461,788	3,646,087	5,108,264
$ 1,268,887	$ 1,461,788	$ 3,646,087	$ 44,953,881
$ 6,385,525	$ 4,812,576	$ 7,267,408	$ 28,031,275
$ 2,105,364	$ 1,577,690	$ 7,073,815	$ 13,608,369
311,857	1,617,001	2,746,810	5,671,867
36,808	102,475	17,987	239,674
$ 2,454,029	$ 3,297,166	$ 9,838,612	$ 19,519,910

Table 2

Oil Sands Technology and Research Fund
Eleven-Year Summary
For the years ended March 31

Statement of Revenue
Expenditure & Fund Balance
(continued)

	1986	1985	1984
Enhanced Recovery Conventional Oil			
Vikor Resources Ltd.	$ (698,262)	$ (1,036,981)	$ 4,570,621
PanCanadian Petroleum	99,194	334,175	116,017
Norcen	17,664	9,613	3,513
Bow Valley, Cold Lake Heavy Oil	2,397,730	5,663,041	111,290
Hudson's Bay Oil & Gas	1,437,929	—	—
Completed Projects	1,476	(6,439)	613,199
	$ 3,255,731	$ 4,963,409	$ 5,414,640
Bitumen Upgrading			
Residue Utilization Project	$ 255,100	$ 521,675	$ 23,730
Heavy Oil Upgrading Demo Centre	44,622	20,391	13,061
Bitumen/Water Transporation Study	(3,744)	15,751	—
California Synfuels	—	33,859	223,378
Gulf Oil - Donor Process	4,110,225	437,000	390,000
Murphy Oil	16,593	28,049	—
Acres Davy McKee	40,000	20,000	—
Toyo Engineering	188,847	—	—
Completed Projects	—	36,944	387,584
	$ 4,651,643	$ 1,113,669	$ 1,037,753
Technology Handling			
Data Base Administration	$ 480,930	$ 502,730	$ 654,653
AOSTRA Journal	149,749	124,471	32,353
Patent Costs	62,851	68,142	110,307
AOSTRA Technical Handbook	219	—	—
Completed Projects	—	—	—
	$ 693,749	$ 695,343	$ 797,313
Training Activities	$ 270,129	$ 243,757	$ 328,732
International Activities	$ 109,690	$ 444,666	$ 325,160
Authority Costs	$ 471,612	$ 37,726	$ 121,980
	$ 49,344,788	$ 73,858,568	$ 37,717,542
Excess of Revenue over Expenditures	$ 2,811,616	$(21,801,760)	$ 18,770,565
Fund Balance at Beginning of Period	$ 3,326,018	$ 25,127,778	$ 6,357,213
Fund Balance at End of Period	$ 6,137,634	$ 3,326,018	$ 25,127,778

1983	1982	1981 and Prior	Total
$ —	$ —	$ —	$ 2,835,378
—	—	—	549,386
85,289	—	—	116,079
240,260	—	—	8,412,321
—	—	—	1,437,929
58,560	328,161	35,557	1,030,514
$ 384,109	$ 328,161	$ 35,557	$ 14,381,607
$ 10,645	$ —	$ —	$ 811,150
—	—	—	78,074
—	—	—	12,007
—	12,757	—	269,994
—	—	—	4,937,225
—	—	—	44,642
—	—	—	60,000
—	—	—	188,847
1,682,790	689,639	1,627,375	4,424,332
$ 1,693,435	$ 702,396	$ 1,627,375	$ 10,826,271
$ 549,409	$ 333,810	$ 435,916	$ 2,957,448
5,334	—	—	311,907
45,886	52,277	144,807	484,270
—	—	—	219
—	—	91,865	91,865
$ 600,629	$ 386,087	$ 672,588	$ 3,845,709
$ 289,725	$ 207,109	$ 200,439	$ 1,539,891
$ 232,466	$ 244,408	$ 177,005	$ 1,533,395
$ —	$ —	$ 636,762	$ 1,268,080
$ 37,805,282	$ 32,858,911	$129,349,519	$360,934,610
$ 4,571,195	$ (881,350)	$ 2,667,368	$ 6,137,634
$ 1,786,018	$ 2,667,368	$ —	$ —
$ 6,357,213	$ 1,786,018	$ 2,667,368	$ 6,137,634

Auditor's Report and Financial Statements

Alberta Oil Sands Technology and Research Authority
Oil Sands Technology and Research Fund
Financial Statements
March 31, 1986

Auditor's Report

Balance Sheet

Statement of Revenue, Expenditure and Fund Balance

Notes to the Financial Statements

ALBERTA LEGISLATURE

OFFICE OF THE AUDITOR GENERAL

Auditor's Report

To the Members of the Alberta Oil
Sands Technology and Research Authority

I have examined the balance sheet of the Alberta Oil Sands Technology and Research Authority - Oil Sands Technology and Research Fund as at March 31, 1986 and the statement of revenue, expenditure and fund balance for the year then ended. My examination was made in accordance with generally accepted auditing standards, and accordingly included such tests and other procedures as I considered necessary in the circumstances.

In my opinion, these financial statements present fairly the financial position of the Fund as at March 31, 1986 and the results of its operations for the year then ended in accordance with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

Donald D. Salmon

C.A.
Auditor General

Edmonton, Alberta
June 23, 1986

Alberta Oil Sands Technology and Research Authority
Oil Sands Technology and Research Fund

Balance Sheet

As At March 31, 1986

ASSETS	1986	1985
Current:		
Cash	$11,692,706	$ 7,337,583
Deposits in trust (Note 3)	1,657,694	2,694,143
Deposits on projects, net (Note 4)	487,062	2,214,826
Accounts receivable	3,572,192	1,899,745
Prepaid expense	6,052	10,874
	$17,415,706	$14,157,171

LIABILITIES AND FUND BALANCE		
Current:		
Accounts payable	$ 9,505,160	$ 7,910,820
Holdbacks payable	1,772,912	2,920,333
	11,278,072	10,831,153
Fund balance	6,137,634	3,326,018
	$17,415,706	$14,157,171

The accompanying notes are part of these financial statements.

Statement of Revenue, Expenditure and Fund Balance

As At March 31, 1986

	1986	1985
Revenue:		
Contributions by the Province of Alberta		
Alberta Heritage Savings Trust Fund (Note 6)	$50,000,000	$50,000,000
Technology sales	2,156,404	2,056,808
	52,156,404	52,056,808
Expenditure:		
Underground access	15,726,767	19,452,415
Institutional research	10,289,985	10,589,050
In situ oil sands, net	6,820,315	26,441,574
Mining and extraction	4,081,376	3,549,014
Bitumen upgrading	4,651,643	1,113,669
Enhanced recovery	3,255,731	4,963,409
Carbonate trend	2,234,802	4,380,864
Heavy oil, net	738,989	1,947,081
Technology handling	693,749	695,343
Authority costs	471,612	37,726
Training activities, net	270,129	243,757
International activities	109,690	444,666
	49,344,788	73,858,568
Excess of Revenue over expenditure for the year	2,811,616	(21,801,760)
Fund balance at beginning of year	3,326,018	25,127,778
Fund balance at end of year	$ 6,137,634	$ 3,326,018

Notes to the Financial Statements

March 31, 1986

Note 1 Authority

The Alberta Oil Sands Technology and Research Authority operates under the authority of the Oil Sands Technology and Research Authority Act, Chapter 0-6, Revised Statutes of Alberta 1980.

Note 2 Significant Accounting Policies

The statements present Fund transactions only, therefore, administration costs charged to the General Revenue Fund are not shown in the statement of revenue, expenditure and fund balance but are disclosed in Note 7.

Expenditures from the Fund are not capitalized due to the intangible nature of assets that may accrue to the Authority. The Authority will be entitled to share in any assets remaining at the end of a project in proportion to its percentage of participation.

A statement of changes in financial position is not provided as disclosure in these financial statements is considered to be adequate.

Note 3 Deposits in Trust

Deposits in trust consist of deposits in the General Trust Fund of the Province of Alberta

Note 4 Deposits on Projects

The amount of $487,062 (1985 $2,214,826) shown on the balance sheet represents the net excess of cash calls on projects over actual expenditures.

Note 5 Advances from the Province of Alberta

The Oil Sands Technology and Research Authority Act provides for advances from the General Revenue Fund of the Province of Alberta not to exceed $100,000,000.

Note 6 Contributions by the Province of Alberta

The Appropriation (Alberta Heritage Savings Trust Fund, Capital Projects Division) Act, 1985-86 provided for payments to the Authority to a maximum of $50,000,000 for the year ended March 31, 1986 (1985 $50,000,000). Amounts actually received from this source totalled $50,000,000 (1985 $50,000,000). The provision which enables the Authority to receive funds up to the stated maximum lapses at the end of the fiscal year.

Note 7 Administration Costs

Administration costs of the Authority, provided for by Section 13 of the Act, are paid by the Province from funds appropriated for that purpose and are summarized as follows:

	1986	1985
Salaries and wages	$2,045,637	$1,696,585
Fees and commissions	442,747	627,953
Rental of property and equipment	305,479	397,724
Travelling and hospitality	237,341	181,740
Employee benefits	234,929	205,731
Materials and supplies	129,180	80,363
Furniture and equipment purchases	15,830	7,542
Telephone and telegraph	14,447	14,033
Advertising	11,855	—
Equipment maintenance	11,633	27,793
Freight, express and postage	8,754	19,965
Grants	4,262	1,225
Staff relocation costs	576	12,443
	$3,462,670	$3,273,097

Note 8 Commitments

In addition to the total expenditure, the Authority had outstanding commitments as at March 31, 1986 totalling $72,011,025 (1985 $93,973,867) for approved projects.

Note 9 Contingent Liabilities

The Authority is involved in a number of legal proceedings. Claims against the Authority in these proceedings, which have not been reflected in the financial statements, amount to $7,200,000. While the ultimate outcome of these proceedings cannot be determined at this time, it is the opinion of management that the disposition of these cases will have a minor effect on the financial position of the Authority.

Note 10 Approval of Financial Statements

These financial statements were approved by management.